THE AWARENESS AND ACCEPTANCE

OF WEB-BASED TRAINING BY

RURAL FIREFIGHTERS

By

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Abstract:

Fire service agencies recognize the potential for distance education to help reduce the number of accidents and injuries experienced by firefighters, and many have implemented web-based delivery systems. However, little information exists concerning rural firefighters' knowledge and use of web-based training.

This exploratory study consisted of five survey sessions conducted at rural departments located in different counties in South Carolina. Participants included firefighters who attended a regular training meeting at one of the five locations. The group included mostly Caucasian males, with ages ranging from 20 to 78. A printed questionnaire served as the data collection source, which addressed access to technology, sources for training information, previous training experience, opinions concerning web-based training, and possible improvements for web-based training delivery. Fifty-four firefighters submitted valid questionnaires.

Rogers' *Diffusion of Innovations* served as a theoretical framework to determine whether rural firefighters knew about web-based training and had made the decision to use it. Rogers described the decision to adopt an innovation as a five-stage process. This study discussed the diffusion of web-based training in the context of the knowledge and persuasion stages of the adoption process. The data analysis showed the level of awareness of web-based training was extremely low. The one-way analysis of variance test showed that the level of awareness significantly differed according to age. Post hoc comparisons indicated the statistically significant difference occurred between those in their 40s, who were the most aware of web-based training, and those over 60, who were the least aware. Comparisons based on other demographic characteristics were not significant. Likert-type items for the level of persuasion to use web-based training indicated views toward it were only slightly more favorable than unfavorable. Respondents reported the lack of high-speed internet as the primary barrier to web-based training. Other factors included limited free time, no access to a computer, a lack of web-based training experience, and not knowing about web-based training opportunities. Technology grants for fire stations, improved marketing efforts, and in-person demonstrations on how to use a web-based course could increase its adoption.

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CHAPTER I

INTRODUCTION

Each year, an average of 80 or more firefighters die in the line of duty in the United States (U.S.), while tens of thousands are injured, the largest group of which are volunteers (Fahy, LeBlanc, & Molis, 2015). The investigations following many of these incidents often cite a lack of training as a factor that contributed to the loss of life (Cox, 2012). Increasing the availability of training options can provide personnel with the knowledge and skills needed to improve personal safety and response efficiency.

Rapid changes in society, partially fueled by developments in technology, have necessitated additional professional requirements for emergency responders (Holmgren, 2012). Because of this, researchers have advocated for changes in firefighter education and training (Baigent et al., 2003; Holmgren, 2012). Since firefighters often face time and travel constraints that make it difficult to attend classes in person (U.S. Fire Administration, 2007a; NVFC, 2010), many fire service leaders have implemented alternative training delivery methods. Web-based learning creates additional training opportunities for firefighters and other emergency responders because of the flexibility and convenience of its delivery system (Haden, 2008; Sprenger, 2002; Somers, 2007). It also can shorten the time needed for face-to-face instruction and reduce exposure to

hazardous situations, while enabling instructors to better track student progress (Sprenger, 2002). Studies also have confirmed that instruction delivered fully or partially online can be as effective as learning activities conducted in a traditional classroom (Nowell, 2011; Lahti, Hatonen, & Valimaki, 2014; De George-Walker & Keeffe, 2010; Hurst, 2015). Agencies have implemented web-based delivery with the general assumption that these systems provide additional training options for all firefighters. However, little evidence exists that indicates rural firefighters know about and use web-based training.

Background of the Problem

The need for alternative, low-cost training opportunities has become especially important for rural firefighters. In rural areas with sparse populations, citizens often depend on volunteers for community fire protection (McLennan & Birch, 2005). Even though volunteer firefighters freely offer their time to serve their community, fire protection never comes without a cost. Firefighters require personal protective gear, firefighting equipment, vehicles, fuel, offices, computers, and professional development (Snook & Olsen, 2006). In contrast, cities and suburban communities usually have a large enough call volume to justify paying firefighters' salaries. However, volunteers fill the ranks of virtually all rural fire departments (USFA, 2007b). Many rural volunteer departments have limited financial resources (USFA, 2007b), and they often rely on community fundraisers, government grants, and the donation of used equipment from larger fire departments (Chihuly, 2013). Funds that otherwise could be used for training

must be spent on fuel for vehicles that travel greater distances to serve a scattered population (Hassel & Dean, 2015).

To compound the problem, throughout the U.S., the recruitment and retention of volunteer firefighters has become an ongoing issue (NVFC, 2012). Volunteer firefighters comprise about 69 percent of the U.S. fire service (NVFC, 2015). Overall, the number of volunteer firefighters available to protect the growing population has proportionately declined over recent years. As younger people move away from rural areas, the average age of the rural population has increased more quickly than the overall population (McLennan & Birch, 2005). People do not have the time to serve, nor can they commit to serving for a long period (McLennan & Birch, 2005). Volunteers who quit the fire service often say they cannot spare the time needed to participate in training (NVFC, 2015; Greene, 2016; Simpson, 1996).

Many fire training organizations across the U.S. have adopted various forms of web-based delivery to increase access to training opportunities, improve firefighter safety, and reduce overall training costs for departments (Jerin & Rea, 2005). Researchers report that various forms of computer-based training provide convenient and acceptable training options for emergency responders and that it can complement traditional training methods (Burkhammer, Lawner, & Berge, 2012; Donavant, 2009; Jerin & Rea, 2009; NVFC, 2010; Ruan, 2005; Somers, 2007; Taber, 2008).

The various firefighter roles require different types of approaches to training. For example, awareness-level hazardous materials (hazmat) courses train emergency responders to recognize the presence of a hazard and accurately report the incident. Hazmat operations-level training provides instruction on defensive actions, and highly

specialized technician-level training enables emergency responders to take offensive actions. For awareness-level courses that teach introductory-level topics, organizations often use self-guided courses. Organizations with a production staff sometimes develop their own courses using software programs such as Articulate or Storyline to animate PowerPoint slides and embed audio, video, and interactive components (Figure 1-1). These organizations often host advanced topics on a learning management system (LMS), such as Moodle or Blackboard, which enables students to interact asynchronously with the instructor and with each other. For topics that require hands-on skill development, training academies sometimes offer blended or hybrid courses that require firefighters to complete a portion of the course online, and then attend face-to-face sessions. Although often viewed as a way to provide training opportunities to those with little spare time and few options, little research exists to show the extent to which rural firefighters—members of a group with a tremendous need for training—take advantage of web-based training delivery.

A Screen from an SCFA Fully Online Course

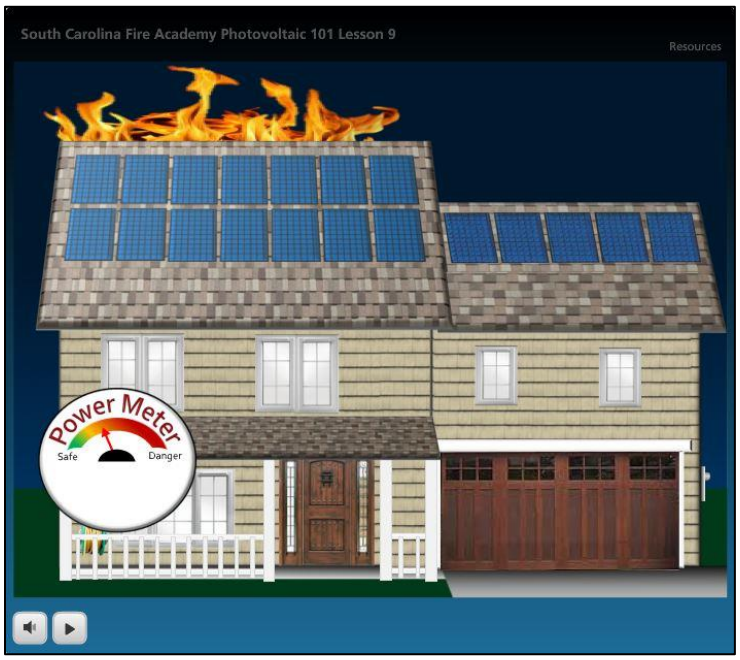

Figure 1-1. Screen capture from the SCFA web-based course *Photovoltaic 101*.

Differences between Rural and Urban Firefighters

In the United States, cities with a population greater than 100,000 often hire career (salaried) firefighters to protect their communities. Smaller, mid-sized cities with populations ranging from 10,000 to 100,000 often rely on combination fire departments comprised of a mix of career and volunteer firefighters. Volunteer firefighters usually serve small towns with fewer than 10,000 residents (NVFC, 2015; Haynes & Stein, 2016).

All firefighters, whether volunteer or career, face dangerous situations when responding to emergencies. In addition to suppressing fires, they mitigate hazardous materials, provide assistance with vehicle accidents, and perform special rescues. However, major differences exist between rural and urban fire departments in terms of

staffing, services provided, resources available, and the types of emergencies they typically face (Chihuly, 2013; USFA, 2007a). For example, firefighters in large and small cities may fight fires in high-rise buildings, shopping malls, large apartment complexes, and densely populated neighborhoods (Rowett, 2015). Emergencies for rural firefighters more often include grass fires, burning cars on highways, rural structural fires, acreage fires, and fires in manufactured homes.

Differences in training requirements often exist as well. The National Fire Protection Association (NFPA) sets the training standards required for national certification, but some states do not require minimum training standards for firefighters. Larger cities may employ emergency responders who are highly trained for unique situations, such as technical rescues, natural disasters, and terrorist incidents. Ideally, all firefighters, whether career or volunteer, would hold national certification, but research shows few rural departments could financially afford to maintain these requirements (Ray, 2012; Boyd, 2014).

The Occupational Health and Safety Administration (OSHA) requires firefighters be trained at a level commensurate with the activities and tasks they perform while on duty (OSHA, 2015). In some states, the local fire chief determines the level of training required for fire department personnel to meet state OSHA requirements (NIOSH, 2009). State training organizations sometimes hold evening or weekend courses on a particular topic specifically for volunteers. Otherwise, on a typical “drill night” at a small, rural fire station, members sometimes have projects that take priority over training, such as repairing equipment, servicing vehicles, and fundraising (Meyer, 2003). In many instances, if volunteer firefighters do not receive formal training through their local

department and cannot attend regional training events, they may not receive any training at all. In addition, since rural volunteers respond to fewer calls, they have less on-the-job experience than career firefighters.

Volunteer fire departments save communities a tremendous amount of money, not just in the cost of salaries (McLennan & Birch, 2005), which totals around $140 billion annually (Brown & Urbina, 2014), but also in reduced insurance rates for homeowners, farmers, ranchers, and business owners. Although they may face many challenges, volunteers who generously donate their time for the greater good—and often spend their own money to purchase personal safety gear—provide assistance to many citizens throughout the country who otherwise would have limited fire protection and other emergency services (Chihuly, 2013).

Each year, while working at an emergency scene, many firefighters receive injuries that result in the loss of life. However, heart attacks that occur even hours after the event, car crashes in personal vehicles while traveling to an incident, misuse of equipment, falling at the firehouse, training mishaps, suicides, and many other causes also claim the lives of firefighters (Fahy, Molis, & LeBlanc, 2016). Although firefighting constitutes a hands-on profession, web-based training can increase awareness of, and change attitudes toward, health and wellness, the prevention of trips and falls, incident scene safety, fire behavior, building construction, standard operating procedures (SOPs), post-traumatic stress disorder (PTSD), and many other topics. This underscores the importance of continued research in this area.

Problem Statement

Fire-training agencies recognize the potential for distance education to increase training options for firefighters and, as a result, many have implemented web-based delivery systems (Maxfield & Fisher, 2012). Although online training providers frequently receive feedback from their students, they know much less about those who have not yet adopted their courses.

To date, research focused on fire service curriculum and other training materials is nearly non-existent (Tarr, 2007), and studies related to web-based fire service training are largely missing (Holmgren, 2014a, 2014b). Furthermore, studies that investigate the use of web-based training for rural volunteer firefighters are exceptionally rare. Although training academies often launch online training initiatives to increase access to critical training opportunities, no studies were located that show whether firefighters in rural areas can and do take advantage of web-based training options. Knowing this information could improve training delivery for rural firefighters, determine ways to increase awareness and use of these additional training options, and potentially reduce the number of accidents, injuries, and deaths.

Purpose and Context of the Study

This study explores the level of awareness and use of web-based training among firefighters in selected rural counties of South Carolina, USA. This study uses Rogers' *Diffusion of Innovations* (DoI) as a theoretical lens. In the early 1960s, Rogers identified characteristics of an innovation that affect the rate of its diffusion, or widespread use, in a given population (Moore & Benbasat, 1991). This theory provides a means for studying

factors that influence the acceptance of an innovation, and it has long been used to provide important insight for those advocating new ideas or new learning technologies in a social setting (Straub, 2009; Surry & Farquhar, 1997). In the context of this study, DoI can enable an understanding of how factors such an individual's needs, social system, and communication channels can influence the adoption of web-based training among rural firefighters.

DoI theory includes Rogers' Five Stages Innovation-Decision Process model, described at length in the next chapter. This study primarily focuses on the knowledge and persuasion stages of this model. Rogers (2003) argued, "Knowing about an innovation is quite different from using it…" (p. 174), because potential users may know about an innovation, but not consider it relevant or useful. In the persuasion stage, potential adopters form opinions about the innovation. Individuals seek information in mass media, as well as social reinforcement from peers to confirm or disprove initial thoughts about the innovation. Positive or negative attitudes toward the innovation result from the persuasion stage.

The South Carolina Fire Academy (SCFA) launched their first web-based course in 2010. The South Carolina State Firefighters' Association (SCSFA) began promoting the use of web-based training materials in 2012 (R. Dunn, telephone interview, July 17, 2015). Having the support of these opinion leaders helped overcome initial arguments against web-based training in fire departments in urban areas. However, as Rogers (2003) argued, "*Adoption* is a decision to make full use of an innovation as the best course of action available" (p. 177). In other words, individuals may try an innovation but never adopt it or only symbolically adopt it, in which case, the person's behavior did not

actually change. To determine whether rural firefighters have made a commitment to use web-based training, this study focuses only on the knowledge and persuasion stages of the decision-making process.

In the present study, web-based training served as the innovation under investigation. Firefighters completed a printed questionnaire concerning web-based training. This survey instrument helped determine relationships between a variety of influential factors—such as demographics, access to technology, and other characteristics—and the awareness level and reported use of web-based training.

Research Questions

Two main questions guided this study. The first research question is: Do rural firefighters in South Carolina know about web-based training? The following questions provided data to answer the first question:

- Question 1a: Are rural firefighters aware of web-based training opportunities, and are there differences between the levels of awareness by group?
- Question 1b: Which channels of communication do rural firefighters most often use to seek information about training opportunities?

The second research question is: Have rural firefighters in South Carolina been persuaded to participate in web-based training? Three supportive questions targeted the second main research question:

- Question 2a: Do rural firefighters have favorable opinions about web-based training?
- Question 2b: Do rural firefighters participate in web-based training?

- Question 2c: Do rural firefighters perceive barriers to the use of web-based training?

Significance of the Study

Firefighters who lack training put themselves and citizens at risk (Sprenger, 2002). Reports from investigations following tragic accidents serve to underscore the importance of training worldwide. For example, on August 12, 2015, a catastrophic chemical warehouse explosion at the shipping port in Tianjin, China, killed 145 people, including 88 firefighters affiliated with the Tianjin Port and the Tianjin Fire Brigade (Rauhala, 2015). The follow-up investigation raised questions about the training of the young firefighters, many of whom were volunteers in their late teens and early 20s (Huang, 2015). Investigators believed that spraying water on the burning chemicals likely caused massive secondary explosions. Firefighters who were off-duty when the explosion occurred told investigators they were unaware of the presence of dangerous chemicals and they did not receive training on how to suppress industrial fires (Jacobs, 2015).

Experts reported that a lack of training was a contributing factor in a similar accident at a fertilizer plant fire in the rural community of West, Texas, on April 10, 2013. The subsequent explosion killed 10 volunteer firefighters, two civilians who were assisting, and three residents of a nearby neighborhood and it injured more than 200 people. The explosion resulted in a crater 90 feet in diameter and 10 feet deep, and it damaged or destroyed 500 structures, including a nursing home, an apartment complex, three schools, and many homes within 37 city blocks (Texas State Fire Marshal, 2013). A report by the National Institute for Occupational Safety and Health (NIOSH) following

the chemical plant explosion noted that the State of Texas does not mandate minimum training requirements for volunteer firefighters. According to the investigators, the firefighters who responded to this incident did not have sufficient training in performing SOPs, nor did they recognize the hazards associated with ammonium nitrate and other reactive chemicals (NIOSH, 2015).

The fire service in the State of South Carolina also has suffered tragic losses. For example, in late 2010, a car struck and killed a 23-year-old career firefighter and seriously injured another while they worked to extinguish a grassfire alongside an interstate. The accident occurred when the car drove onto the shoulder of the highway after a rear-end collision with a van. The car passed between two fire apparatuses and the guardrail before striking the two firefighters. According to the NIOSH report, the placement of the fire apparatus allowed just enough space for the errant vehicle to pass into the work zone. The report recommended the development of training on SOPs for all types of roadway incidents, with specific instruction on how to position an apparatus to protect emergency workers from oncoming traffic (NIOSH, 2012). In 2013, the South Carolina Fire Academy (SCFA) collaborated with the Columbia Fire Department and the South Carolina Department of Transportation to develop an online traffic incident management course called *Emergency Response to Highway Incidents* in memory of Chance Zobel, the Columbia firefighter who was killed.

For a number of reasons, relatively little academic research exists relating to the use of web-based training by emergency responders, including police (Donavant, 2009), EMTs (Jerin & Rea, 2005; Somers, 2007), and firefighters (Holmgren, 2012; Holmgren, 2014). The literature revealed growing interest in the implementation of web-based

training programs for career firefighters, and most studies show that web-based training offers a viable alternative to traditional training. However, studies that investigate the acceptance and use of web-based training by rural firefighters would seem almost non-existent. Thus, the present study can bridge this gap in the existing literature.

The findings from this research may help guide local fire departments that face training mandates and those who plan to implement a web-based training program. In addition, this study may identify impediments to web-based training delivery for emergency medical responders, police officers, nurses, or almost any professional development or continuing education program for non-traditional learners in rural areas throughout the U.S. and in other countries.

Definitions of Terms

Key terms and phrases used in this study include the following:

Active firefighter—"…member of a fire department or organization in good standing that is qualified to respond to and extinguish fires or perform other fire department emergency services and has actively participated in such activities during the past year (Cornell Law School, n.d.).

Awareness-level training—Training that ensures an individual can identify a hazardous situation, the materials or substances involved, the need for additional resources and assistance, and the possible outcome of the incident (OSHA, n.d.). Self-paced web-based training routinely addresses awareness-level topics.

Barriers to web-based learning or training—"Obstacles students encounter before or during online learning that could negatively affect the learning experience" (Muilenburg, 2008, p. 8).

Blended course—A class format that consists of both online and in-person components. Many authors and researchers use the terms *blended* and *hybrid* interchangeably (Negash et al., 2008, p. 18). However, the South Carolina Fire Academy (SCFA) distinguishes between the two. For this study, a blended course includes initial face-to-face orientation session, followed by a period lasting several weeks in which the student completes web-based lessons at home. At the end, the class meets as a group with the instructor for a full day (R. Dunn, telephone interview, July 17, 2015). See the definition for a *hybrid course* below.

Career firefighter—A person employed to suppress fires who earns the majority of his or her income working for a fire department. "Career firefighters include full-time uniformed firefighters regardless of assignments, e.g., suppression, prevention/inspection, administrative…" who work for public fire departments, and "…they do not include career firefighters working in private fire brigades, or for state and federal agencies" (Haynes & Stein, 2016, p. 1).

Certification—"An authoritative attestment; specifically, the issuance of a document that states that an individual has demonstrated the knowledge and skills necessary to function in a particular fire service professional field" (NFPA, 2011, 1000-6).

Certified firefighter in South Carolina—A person who has successfully completed South Carolina Fire Academy-sanctioned training courses and passed state or national written tests and skills exams (R. Dunn, telephone interview, July 17, 2015).

Combination fire department—A fire department that "…uses both volunteer and paid full-time firefighters to respond to fires, medical emergencies, rescues, and other calls. The mix of paid and volunteer firefighters depends on the size, type, and risk of the community protected, the number of calls for service, the availability of volunteers, and amount of time volunteers can contribute to emergency calls and training. In general, as communities grow larger and the number of emergency calls increase, larger numbers of full-time firefighters are added" (EFPD, n.d., n.p.).

Distance education—"Improved capabilities in knowledge and/or behaviors as a result of mediated experiences that are constrained by time and/or distance such that the learner does not share the same situation with what is being learned." (King, Young, Drivere-Richmond, & Schrader, 2001, p.10).

Fire brigade—"An organized group of employees at a facility who are knowledgeable, trained, and skilled in at least basic firefighting operations, and whose full-time occupation might or might not be the provision of fire suppression and related activities for their employer" (NFPA, 2015, 600-6).

Fire chief—The highest ranking officer or the person in charge of the administration and operations of a fire department (IAFC, 2015).

Hybrid course—A class format that consists of both online and in-person components (Negash et al., 2008). In this study, students in a hybrid course read the textbook, watch web-based videos, and complete interactive online assignments and

quizzes on their own time, in addition to attending regularly scheduled instructor-led supplemental instruction and hands-on skills development (R. Dunn, telephone interview, July 17, 2015). Also see the definition for a *blended course* above.

Junior firefighter—Often a high-school-aged member of a group that engages in youth career exploration activities and fire training drills. Sponsored by a fire department, junior firefighter organizations serve as a means for recruiting future firefighters (NVFC, n.d.).

Nontraditional student—A non-homogeneous group of adult, full- or part-time students who come from diverse backgrounds and have different educational needs and goals (Leverenz, 2000). With an average age 25 or older, these students often must balance school with work, family, and other commitments (Ely, 1997).

Open-enrollment courses—Online, self-guided courses, in which "…learners receive the content media and learn on their own" (Negash et al., 2008, p. 4).

Operations-level training—Training for emergency responders that exceeds awareness-level training, which enables workers to assist technicians and to perform defensive actions during an emergency incident without entering a hazardous area (Noll, Hildebrand, Schnepp, & Rudner, 2012). This type of training requires students perform hands-on skills.

Organizational culture—"The set of basic assumptions and values that shape shared understandings, and the forms or practices whereby these meanings are expressed, affirmed, and communicated to the members of an organization" (Kier, 1995, pp. 69-70; Davidson, 2010, p. 14).

Retention rate—The percentage of individuals who continue to actively serve as firefighters.

Rural—Non-metropolitan and non-micropolitan geographical areas (with no urbanized population), as indicated by the February 2013 map, "Metropolitan and Micropolitan Statistical Areas of the United States and Puerto Rico" (U.S. Census Bureau, 2013).

Traditional learning—Learning "...with physical presence and without e-communication" (Negash et al., 2008, p. 4). In fire service training, an instructor delivers cognitive information in a face-to-face lecture setting and the skills portion in a lab or on a fire training ground (R. Dunn, telephone interview, July 17, 2015).

Training—"The process of achieving proficiency through instruction and hands-on practice in the operation of equipment and systems that are expected to be used in the performance of assigned response duties" (NFPA, 2011; OSHA, 2015).

Volunteer firefighter—An active, part-time (on-call or volunteer), non-paid member of a fire department (Haynes, 2016).

Web-based training (WBT)—Instruction delivered wholly or partially through the internet (Barron, 1998).

Delimitations

The context for this study was deliberately selected. As a former multimedia production coordinator for a leading publisher of firefighter training materials, the researcher had a long-time interest in web-based training. During this same time, the researcher's spouse served as a volunteer for a small, rural fire department in Oklahoma,

in which he was the only member who had received certification-level training. These experiences created an awareness of the lack of training and curriculum resources for rural firefighters. The researcher became acquainted with SCSFA and SCFA staff members through contract development work on curriculum projects and web-based learning initiatives. Familiarity with the South Carolina fire service community influenced decisions concerning the survey location and pool of participants for this study.

Limitations

While an exploratory research approach provides flexibility, these types of surveys have limitations. Researchers cannot measure attitudes and opinions in the same way they measure temperature or barometric pressure. No audiences "stand still" long enough to ensure the complete reliability of a one-time measurement. Fire departments vary from one another and from state to state. In addition, the results of this study represent a snapshot in time, since one sampling cannot reveal the fluctuation of opinions as technology continually advances and as new firefighters join a department and others retire. Rogers (2003) cautioned that DoI does little to address causality in snapshot-type studies. Thus, this poses a limitation.

The analysis must rely on the assumption that all participants provided honest responses. A person's views represent an abstract concept (Hsia, 1988). In this case, the researcher assumed participants made accurate inferences concerning their preferences based on choices provided in the questionnaire.

This study investigated the diffusion of web-based training by asking participants to rely on their memory and recall information such as the year in which they took their first web-based course. According to Rogers (2003), asking respondents to look back in time introduces bias into the research. Rogers recommends gathering data "…from adopters at several points in time during the diffusion process" (p. 113).

Exploratory studies typically involve small samples that may not fully represent the entire population (Singh, 2007). Future researchers could consider drawing from a larger pool of respondents by using a web-based survey and including rural firefighters who work near suburban areas. The results obtained from a larger sample size would likely result in more generalizable results. The present study purposely sought firefighters in specific remote, rural areas. However, Rogers recommended the use of targeted sampling. In addition, while a web- or email-based survey typically elicits more responses than a printed survey, conducting the survey using the internet would likely skew the responses in favor of those who have access to computer devices and a reliable internet connection and, perhaps, would have excluded the audience of interest.

Study Outline

Chapter II presents a literature review that frames the discussion concerning the awareness and use of web-based fire service training. The literature review describes fire service culture and training, problems faced by rural learners, major research contributions that address barriers to web-based training, the theoretical approach to this study, research relevant to fire service training, and the implications for the present study. Chapter III includes descriptions of the research design, the participants, and methods

used to administer the survey instrument. Chapter IV presents the findings, as well as a statistical analysis of the responses submitted by participants. A summary of the study appears in Chapter V, along with a discussion of the results in the context of DoI, and suggestions for future research.

CHAPTER II

LITERATURE REVIEW

Many organizations have implemented web-based training programs to improve safety and to meet the changing role of emergency workers. Training administrators often view web-based course delivery as a way to expand opportunities for those who have few training options and provide time flexibility for their students. This chapter includes a review of previous research related to barriers to web-based learning, as well as studies that address the use of web-based training by emergency responders. To provide a clearer understanding of how web-based training for rural firefighters differs from other learning environments, such as public education, higher education, and corporate professional development training, this chapter includes a description of the organizational culture and traditions of the fire service, firefighter professional training and higher education, and problems faced by online learners in rural areas.

Although administrators and content providers often make the decision whether to implement web-based delivery systems, the attitudes, abilities, and the resources of the students determine the success of implementation (Straub, 2009). Researchers often use diffusion and adoption theories to help explain why individuals choose to either use or reject the use of a technology (Straub, 2009). While diffusion theories view the spread of

an innovation—or a new idea or practice—over time, adoption theories focus on individuals and the choices they make concerning a particular innovation. The work of Rogers' *Diffusion of Innovations* theory offers an appropriate theoretical lens for understanding of factors that influence both of these issues (Straub, 2009). Examples of similar studies based on Rogers' theories help draw parallels to the use of this theoretical frame in the present study.

While most works cited in this study are peer-reviewed academic manuscripts, this literature review also includes trade journal articles and Applied Research Projects (ARPs) listed on the National Fire Academy's (NFA) website. This database served as an important resource for this study because of the limited number of fire service training-related trade publications and academic research journals. The NFA Executive Fire Officer (EFO) Program—a four-year professional development series that includes accredited graduate-level courses—is the preeminent fire service training program in the U.S. Students in this program complete extensive research papers, called ARPs, to investigate administrative issues of importance to their particular fire service organization. Each ARP undergoes a formal peer-review process before being accepted. The NFA's Resource Learning Center website lists EFO ARPs, university theses and dissertations, trade journal articles, and books.

Fire Service Culture

The important relationship between organizational culture, group dynamics, and the facilitation of or resistance to change is well documented (Lucas & Kline, 2008). Organizational culture provides the assumptions and values (Kier, 1995) that bind a

group of employees together and guide their behavior (Stinchcomb & Ordaz, 2007). Cultural dynamics influence organizational planning, networking, and group learning (Greenhalgh, Robert, MacFarlane, Bate, & Kyriakidou, 2004). Adoption becomes more likely if an innovation aligns with organizational values, goals, skills, and available technologies (Greenhalgh et al., 2004). An understanding of organizational culture provides an understanding of system-wide readiness for innovation (Greenhalgh et al., 2004).

Few institutions are more tradition-bound or have a stronger organizational culture than the fire service in the U.S. (Cox, 2012). Although some may refer to the culture as if it were one common entity, culture exists as a dynamic experience based on human interactions (Baigent, 2009), and results from people with different personalities interacting with one another. The social environment of any fire department depends on the people who work there at a given point in time (Cox, 2012). As a result, the term *fire service culture* encompasses many types of behavior.

The fire service functions as a military-like command structure, with subordinates who perform specifically assigned tasks. Although the chain of command may vary among fire departments, firefighters, lieutenants, captains, battalion chiefs, and assistant chiefs systematically report to the fire chief, who serves as the top administrator and head of operations for the fire department (IAFC, 2015). As a paramilitary organization, members of the fire service recognize the importance of *brotherhood* as it relates to their mission to serve and protect the public and one another (Crosby, 2007). In addition, professional firefighters who work shift duty and live at the station 24/7 often develop a culture comparable to an extended family (Stinchcomb & Ordaz, 2007; Cox, 2012). In

the fire service, the idea of *family* also takes on a literal meaning. In many instances, the profession continues as a family legacy when young men and women choose to follow in the paths of older family members who served as firefighters. Close personal bonds enable firefighters to work effectively as a team when performing their duties (Cox, 2012).

In many respects, the structure and traditions have served the fire service well. However, research frequently highlights the influence of organizational culture in many non-corporate organizations, such as civil-military and educational settings, in creating or removing barriers to change (Davidson, 2010; Baigent, 2009; Willower, 1963). A fire department's division of labor enables workers to develop specialized skills, and this organizational structure facilitates productivity and efficiency when responding to an emergency. However, division of labor can sometimes stifle creativity and innovation (Davidson, 2010), as well as any effort to change the system (Cox, 2012). Rank and member status also can influence group learning. Older, higher ranking members have more influence than people with lower status (Levine & Moreland, 1990), and their opinions, actions, and social influences can affect the entire group (Lucas & Kline, 2008).

Fire Service Training and Education

In 2015, 64 percent of all 911 emergency calls responded to by fire departments in the U.S. involved a medical emergency, while fewer than five percent concerned an actual fire. The rest were false alarms, hazardous materials incidents, and mutual aid calls (NFPA, 2016). Between 2005 and 2014, fire-related deaths steadily declined (FEMA, 2016), largely due to the installation of sprinkler systems, but also because of other

factors, such as changes to building codes and fire prevention and education efforts. As a result, agencies have increased emergency medical technician (EMT) training requirements. These statistics also have made an impact on the fire service; fewer fire calls means emergency responders have less on-the-job firefighting experience. On-the-job training serves as an important platform of learning for emergency responders (Sommer & Njå, 2011). In the fire service, professional learning closely aligns with the day-to-day work (Holmgren, 2014b). Hands-on experience becomes crucial because no two emergencies are alike. While training drills take place in a familiar setting, they lack the unpredictability, time pressure, and stress level experienced during an actual emergency (Sommer & Njå, 2011).

Many firefighters who serve rural volunteer departments have less training and practical experience than those who serve urban and suburban departments, because they often receive much less funding and generally have fewer resources overall (NVFC, 2010). The increasing average age of rural volunteer firefighters also affects training. In rural communities comprised of fewer than 2,500 people—communities that often depend on volunteer fire departments—almost half of firefighters are over the age of 40 (NVFC, 2010).

Formal and Informal Training

Fire departments often recruit high school graduates with little or no fire service experience or college education. New firefighters become skilled at their job by participating in formal training, gaining on the job experience, and by informally interacting with more experienced firefighters. Traditional training most often includes

in-person lectures delivered by a training officer or instructor combined with hands-on skills demonstrations and group practice sessions (Holmgren, 2013; Jerin & Rea, 2005). The National Fire Protection Association (NFPA), an international nonprofit organization, develops and maintains training standards required for the various fire service occupational certifications (NFPA, n.d.). Accrediting organizations such as The Pro Board and the International Fire Service Accreditation Congress (IFSAC) ensure courses offered by member organizations adhere to the NFPA professional qualification standards. While laws require firefighters receive adequate training to ensure safety while performing their duties (OSHA, 2015), not all states require certification-level training. In some states, the department's fire chief determines the amount of training needed for personnel to meet OSHA requirements (NIOSH, 2009). Frequent skills training ensures that actions become second nature (Holmgren, 2014b; Sommer & Njå, 2011) and teaches firefighters to work as a team. While engaged in such activities, new firefighters also learn to model the behaviors of those with more experience (Sommer & Njå, 2011).

Firefighters also develop knowledge and competence through storytelling, dinner-table discussions, "and tailboard debriefings" (Sommer & Njå, 2011) (an informal meeting that takes place soon after the emergency event, sometimes on the apparatus tailboard before the firefighters leave the scene). Such discussions greatly influence the thoughts and actions of a department's members, and they enable firefighters to tap into organizational knowledge. Debriefings provide an essential opportunity to reflect and learn from emergency events (Taber, 2008). In many respects, learning from the mistakes of others offers more value than learning from their successes (Sommer & Njå, 2011). In spite of the benefits, some career fire departments and most volunteer departments do not

have a formal system for sharing experiences. Also, since professional firefighters work in shifts, few opportunities exist to discuss matters with the entire group (Taber, 2008). When combined, these factors can create a barrier to learning (Sommer & Njå, 2011).

Higher Education for Firefighters

Since firefighters must continually train to move up in rank, pursuing higher education can prove challenging. Although most fire departments do not require firefighters to have a college degree, many require officers and chiefs to have a bachelor's or master's degree. Kobziar, Rocca, Dicus, Hoffman, Sugihara, Thode, Varner, and Morgan (2009) described the quandary faced by most career firefighters who aspire to advance their career. According to these authors, qualification for upper management positions involves three professional development components—technical training, on-the-job experience, and a college education. Firefighters who enter two-year technical college programs may find it easier to achieve an education while continuing training and gaining experience, but professional positions often require a four-year degree. However, career firefighters often work shift duty, which makes it difficult for them to attend classes at a college or university. In some cases, they may not have agency support or the financial resources to cover the time and costs of pursing a degree. Firefighters who enter college mid-career also may be unprepared for general studies, such as mathematics and science, and may need to take additional remedial courses. To compound the problem, relatively few universities in the U.S. offer programs in fire service administration.

In addition, firefighters often place less value on a graduate degree from a university than advanced fire service credentials, such as those earned through the completion of National Fire Academy programs (Coleman, 2006). Although colleges and universities sometimes incorporate training and experience into their academic programs, they often cannot employ experienced instructors who do not have a graduate degree. Conversely, highly educated instructors may not meet the qualifications to teach at training agencies if they do not have enough practical experience (Kobziar et al., 2009).

Holmgren, (2014b) also has argued that the strong, masculine gender identity traditionally held by firefighters also may indirectly influence attitudes toward academics. Although an increasing number of women have joined the fire service in recent years, historically, the majority of firefighters, instructors, and officers have been male, which has added to the continued perception of firefighting as being a masculine profession (Holmgren, 2014b). Johnson (2006) argued that patriarchal cultures (such as the fire service) often dictate that *feminine* traits, such as a capacity of cooperation and sensitivity, hold less value. These cultures also perpetuate the myth that men are stronger and better at more physically demanding professions such as firefighting, while women are more naturally suited to nurturing professions such as teaching and nursing (Johnson, 2006). Holmgren (2014b) and others have stated that some in the fire service may view theoretical work as a more feminine approach, which has perhaps resulted in a lower status for academic faculty than those with professional fire service experience. Holmgren (2014b) further argued that firefighters who have limited communication skills often prefer the role of practitioner, and they may view theoretical learning as secondary to formal training, on-the-job experience, and abilities to perform practical skills.

The scenarios described by Kobziar et al. (2009) and Holmgren (2014b) shed light on a conflict between firefighters with and without a college education. They also reveal possible reasons why relatively few firefighters pursue post-graduate studies, and why much less academic research exists related to fire service training than related fields, such as nursing education.

Web-Based Fire Service Training

Because of the nature of the work, firefighters must develop hands-on job skills. Not only do they practice applying water and other suppressants on live fires, they must know how to drive vehicles, hoist equipment, climb ladders, ventilate roofs, and many other highly physical activities. Firefighting also requires specialized knowledge on topics such as fire behavior, proper radio communications, building construction, and chemical hazards. In addition, firefighters must develop an attitude of safety, team-spiritedness, and cooperation.

To accommodate this mix of psychomotor, cognitive, and affective learning in an online learning environment, the fire service employs several web-based learning models, ranging from fully to partially online formats. As previously mentioned, fully online, self-guided classes work well for awareness-level topics, such as hazardous materials awareness, highway incident safety, and building construction. These courses often consist of self-paced multimedia courseware. In classes that combine knowledge and skills components, partial online delivery allows students to complete the cognitive and affective portions on the internet, and then participate in skills sessions conducted in person. These partially online courses—typically called *blended* or *hybrid* courses—

include the combination of online (mostly asynchronous) delivery with traditional classroom learning. This mix of training delivery enables communication in a variety of formats, thus allowing students to engage in different ways (Taber, 2008). Courses that leverage the strengths of both online and traditional instruction hold a lot of promise (Button, 2014; Miller, 2014). Several NFA ARPs support the use of blended fire service training (Byrd, 2011; Howard, 2009; Rodgers, 2005). McCabe (2012) even recommended the National Fire Academy establish a learning management system (LMS) and online network for use by small departments that may not otherwise have an ample travel budget or the financial resources to develop their own LMS.

Advantages and Disadvantages of Web-Based Training

Online learning has become a fast-growing trend in many educational settings (Hew, 2015). In recent years, high-speed internet has made distance learning more accessible and has given rise to virtual training centers, with courses taught completely online, as well as blended learning offered as an extension of traditional training. Numerous research studies involving adult learners, in post-secondary institutions and career settings, have confirmed web-based learning can be as effective as learning activities conducted in a traditional classroom (Means, Toyama, Murphy, Bakia, & Jones, 2009).

Research also has shown that online learning offers an acceptable alternative means for delivering training in emergency response and related professions, such as nursing (Lahti, Hatonen, & Valimaki, 2014), emergency medical services (Somers, 2007), public safety (Byrd, 2011), law enforcement (Donavant, 2007; Zengin, 2010), and

fire service training (Howard, 2009). Many training organizations have adopted web-based delivery for administrative reasons, such as ease of scheduling (Abee, 2001), the ability to accommodate a wide variety of learner preferences (Somers, 2007), instructor and student convenience, cost savings (Jerin & Rea, 2009), increasing the frequency and quality of training, and reducing the need for firefighters to leave the station (Watkins, 2010).

In spite of the benefits, the web may not provide the best option for training delivery for all students in every situation, nor does the implementation of web-based delivery guarantee learning will occur (Somers, 2007; Hew & Cheung, 2014; Rai & Chunrao, 2016; Terras & Ramsay, 2015). While the vast majority of studies have proven the benefits of web-based learning, a few have produced mixed results or received poor reviews from students (Hassel & Dean, 2015; Somers, 2007). For example, although Donavant (2009) found no significant difference in outcome between online and traditional professional development police training and that the majority of students believed online learning was appropriate, more students preferred traditional classroom instruction. Luedtke (2009) reported that computer-based training with no interaction between students and an instructor received poor reviews among firefighters in two Wisconsin fire departments. In Weston's 2009 study involving student soldiers, an overwhelming number of participants had negative comments about the U.S. Army's distance learning courses.

While web-based delivery can expand the reach of an educational institution, some researchers doubt the effectiveness of learning that takes place (Hew & Cheung, 2014; Somers, 2007). Those who doubt the effectiveness of web-based training may

resist the implementation of new technology-based training programs (Somers, 2007). This attitude has even appeared in internet memes (Figure 2-1). People will naturally show some level of resistance if they feel they lack information or the skills necessary to accomplish a task (Illeris, 2009; Willower, 1963).

Firefighter Training-Related Internet Meme

Figure 2-1. Internet meme located on Twitter with the caption, “Love for the job is not taught on-line” (Cunningham, 2016).

Although digital delivery can save money over the long term in many instances, the initial setup of these systems often comes with a significant cost. In a 1999 Executive Fire Officer applied research project (EFO ARP), Adams determined the need for computer-based training (CBT), but his Florida volunteer fire department did not have an adequate budget for implementation. When Ivan (2009) investigated whether

teleconferencing could provide an effective means of delivering the cognitive portion of fire training for members of an island-based volunteer fire department in Michigan—firefighters who had not been able to attend training for many years due to travel issues—his results showed that teleconferencing may not be cost effective in all situations. Factors included the cost of the equipment, the number of students who needed training, the length of the course, and the amount of travel involved. He also reported that teleconferencing minimized the need for travel, but it did not eliminate it (Ivan, 2009).

Web-Based Training Providers Relevant to This Study

The State of South Carolina served as the location of this study. Two statewide agencies provide most of the traditional and web-based training for firefighters in the state—the South Carolina Fire Academy (SCFA) and the South Carolina State Firefighters' Association (SCSFA). Although several Association staff members serve on the advisory board for the Academy, SCFA and SCSFA are completely separate entities. Other agencies around the country also provide no-cost or low-cost online training options available to South Carolina firefighters, such as the National Fire Academy (NFA), the National Fallen Firefighter Foundation (NFFF), the National Volunteer Firefighter Council (NVFC), Texas A&M Engineering Extension Service (TEEX), Responder Safety, Target Solutions, and many others.

The South Carolina Fire Academy, located on the outskirts of Columbia, stands as one of the most comprehensive fire training facilities in the United States. The 208-acre campus and buildings include a dormitory that accommodates more than 100 trainees, a cafeteria, an auditorium, and several classrooms. The fireground facilities include multi-

story burn buildings, a five-story drill tower, several flammable liquids props, aircraft crash simulators, tank and railcars for hazardous material simulations, and other confined space, residential, and industrial and commercial configurations (SCFA, 2014). The Academy offers both International Fire Service and Accreditation Congress (IFSAC) and National Board on Fire Service Professional Qualifications (Pro Board) certifications for 18 subject areas. In fiscal year 2015, SCFA provided 2,505 training programs for 27,370 successful students (Kerber, 2015).

In 2010, the Academy launched their first web-based course—a blended version of their Fire Officer I—which is now one of many SCFA training courses that feature online learning components. Other early releases included a Fire Instructor blended course and a Hazardous Materials Operations hybrid. The agency gradually increased their production staff, which has enabled them to develop their own interactive multimedia courses and other online training materials, and they manage their own learning management system (LMS). In 2015, the Academy provided online training to more than 6,700 firefighters (Kerber, 2015). The following is a list of SCFA's fully online courses and the year of release:

- Hazardous Materials Awareness, 2010
- ISFSI—Modern Construction Considerations for Company Operations, 2012
- Emergency Vehicle Response Awareness, 2012
- Improving Tactical Decision Making, 2012
- ISFSI—Thinking Firefighters, 2013
- Emergency Response to Highway Incidents, 2013
- Fire Chief 101, 2014

- Photovoltaic 101, 2015
- Introduction to Technical Rescue, 2015

Whereas SCFA provides job-ready and certification-based training, SCSFA's role is to advocate and communicate. The Association trains in partnership with various organizations or through conferences and continuing education opportunities. They provide insurance, legislative representation, and other benefits to the state's fire service. Employees of the Association routinely travel throughout the state, attend fire department functions, and meet with firefighters face to face.

In early 2012, SCSFA launched their LMS with the goal of offering a one-stop shop for training information. The site includes instructor materials available as downloadable files, as well as links to free and low-cost web-based courses available from other agencies. Volunteers maintained the site for the first few years. In 2016, the Association hired a part-time training content specialist to manage the site. As of May 2017, SCSFA's LMS-based materials included nearly 400 individual resources in more than 30 firefighter-related subject areas. Training officers and instructors periodically contribute resources they have developed.

Both SCFA and SCSFA receive strong funding support in comparison to similar fire service agencies in other states. The staff members of both agencies have earned reputations for serving their state's fire service with a high degree of professionalism. The fact that both of these statewide agencies have an interest in online training made South Carolina a particularly desirable research venue.

Barriers to Web-Based Learning

Despite the advances in education and communications technology over the last 25 years, the literature showed that a long list of factors often present challenges to web-based learning. This section provides a description of prior research that contributed to the development of the survey instrument for this study.

The work of Muilenburg and Berge (2001, 2005) serves as an important foundation for subsequent research that addressed barriers to distance learning in a wide range of fields. Muilenburg and Berge (2001) conducted a series of seminal studies that investigated barriers to online learning from the perspective of K-12 teachers, adult educators, higher education faculty, administrators and managers, corporate trainers, and students. To gain a broad understanding, Muilenburg and Berge (2001) initially surveyed people in a wide variety of roles in many educational settings and conducted a literature review to identify factors that impede distance education. Using factor analysis, they created a list of 10 underlying constructs that comprise barriers to distance education. According to these researchers, these 10 factors can serve as a basis for future studies:

- Administrative structure
- Organizational change
- Technical expertise
- Social interaction and quality
- Faculty compensation and time
- Threat of technology
- Legal issues

- Evaluation/effectiveness
- Access
- Student-support services

In a related study, Muilenburg and Berge (2005) found that student barriers to distance education include a perceived lack of social interaction with other students, a lack of commitment and motivation to complete homework and participate in an online course, and negative perceptions and attitudes of administrators and educators, which can influence the beliefs held by students. These researchers identified several variables that have the most impact on student barriers to distance education. These include the level of self-confidence, perceived effectiveness of distance learning, previous online learning experience, and the anticipated level of enjoyment (Muilenburg & Berge, 2005). Results also showed that learning barriers decreased as students completed more online courses, and student confidence, motivation, and social interaction increased with experience.

Impediments to Web-Based Fire Service Training

Academic researchers in emergency response fields have reported many of the same issues originally addressed by Muilenburg and Berge (2001, 2005), particularly concerning student motivation (Somers, 2007; Jerin & Rea, 2005; Holmgren, 2012) and interaction in an online setting (Donavant, 2009; Taber, 2008). Although students often cite the ability to work independently at their own pace and in a manner that suits their individual learning preferences as a benefit of web-based learning (Ruan, 2005), the flexibility of web-based learning shifts greater responsibilities to the student (Holmgren, 2012; Salbashian, 2009). Holmgren (2013), who studied barriers to web-based firefighter

training, argued that low-achieving vocational students sometimes struggle to adjust in an online environment, where they must assume more responsibility for their learning. The means of communication in an online classroom differ from those in a traditional setting (Holmgren, 2012). In an online classroom, communication takes the form of written communication, rather than lectures and discussions (Holmgren, 2013). The emphasis on written communications can present a barrier to students with lower education levels or those who find it difficult to put their thoughts in writing (Holmgren, 2012; Salbashian, 2009). Students may oppose these shifts in responsibility if they have little prior knowledge or experience in this type of learning environment (Holmgren, 2013).

Several studies have identified barriers to web-based training for firefighters in Sweden. Holmgren (2014a) used Activity Theory to describe how the transition from traditional (face-to-face) instruction to distance learning has affected the role of a fire service instructor. His subjects were knowledgeable firefighters and experienced classroom instructors, but many had limited experience facilitating learning in an online setting. The researcher interviewed instructors and conducted a series of focus groups with students. The results showed that many fire instructors struggled in a web-based classroom environment due to their lack of familiarity with the technology, and because online delivery did not fit their usual teaching style. The shift toward learner-centered instruction created an alternative pedagogy in which students took on more responsibility for their learning. However, a lack of questions from students and the inability to interpret their immediate reactions made the instructors feel they were no longer the primary source for learning. Holmgren (2014a) argued that a lack of professional development and support for instructors could lead to problems for online students. He

reported that when instructors felt overwhelmed when managing both online and on-campus course environments, they tended to place priority on the campus setting.

Holmgren (2014a) explained that the evolution of the system must allow for a fit with current teaching and learning methods. Otherwise, instructors may not feel qualified to teach online, or they may tend to replicate their traditional teaching practices in an online classroom. Overall, Holmgren (2014a) confirmed that a lack of familiarity with online instructional delivery methods and a lack of organizational readiness results in a reluctance to try new teaching strategies.

In a related study, Holmgren (2015) compared student-learning processes in traditional and distance fire service training courses. The on-campus training model revealed no concerns. However, in the blended course, students seemed unclear on how to prepare for in-person training or the theoretical components of the course, and some complained of a lack of online instructor support. Students also felt the asynchronous and synchronous technologies inhibited communication and collaboration. To deal with these issues, the online students adjusted to using self-directed learning strategies and assumed greater responsibility for the preparation and planning of their studies. In the hands-on portion of the course, the online students were more problem-oriented and acted more independently than the students in the traditional course. The online students relied less on the instructor and more on the knowledge they acquired while studying on their own. According to Holmgren (2015), this finding may support the use of blended learning that integrates face-to-face theoretical instruction with practical skills training. However, he also noted this self-reliance tended to taper off, meaning the online students' study habits and dependency on the instructor more closely resembled those of traditional students

later on in the course. The results revealed shortcomings for distance learners concerning instructor support and the limitations of technology. Although the feeling of isolation was a common complaint among online learners in other research studies, students in this study seemed to adapt to online learning rather quickly. The researcher recommended that program directors and instructors investigate opportunities for knowledge interactions unique to online learning in an effort to facilitate change in fire service training.

Problems for Rural Learners

Learners who live in rural areas often face a different set of issues than students in secondary schools, colleges and universities, and work-related professional development programs because of their remote setting and limited community resources (Hannum, Irvin, Banks, & Farmer, 2009; Johnson & Strange, 2007). The fact that thousands of firefighters serve and reside in rural communities could greatly impede opportunities to participate in training for many reasons, most prominently because of the increased likelihood of a lower income, lower education level, less free time, and less access to technology and the internet.

Income

Although rural living can offer many benefits, such as a quieter lifestyle and a less polluted environment, citizens living in rural areas often face certain disadvantages. Location has important implications that can affect many aspects of people's lives, including economics and access to public services and education (Prins, Campbell, &

Kassab, 2014). For example, while rural residents usually enjoy a lower cost of living, employers in rural areas often do not offer salaries that compete with larger, urban-based companies (Hassel & Dean, 2015). For many, the cost of tuition can hinder participation in online courses (Butcher & Rose-Adams, 2015).

Education

The average education level of a community affects the prosperity of local economies in both rural and urban areas (Marré, 2014). Low adult income and educational attainment and fewer community resources often reinforce one another (Johnson & Strange, 2007). Rural residents tend to have a lower educational level overall (Prins, Campbell, & Kassab, 2014). For example, Prins et al. (2014) reported that one in five rural residents have a college degree, compared to one in three residents in urban areas of the State of Pennsylvania. Those with less education also tend to have less experience taking online courses and are less likely to believe they would enjoy learning online (Rabiee, Nazarian, & Gharibshaeyan, 2013). In a study involving EMTs, Somers (2007) also stated that previous online learning experience influences online student satisfaction and efficacy.

Free Time

Students who drop out of online courses often cite internal factors, life events, and lack of support (Terras & Ramsay, 2015). Those who live in lower income households often have additional time constraints. *Time poverty* (Butcher & Rose-Adams, 2015), which results from such pressures as having to work more than one job or other family

responsibilities, can prevent people from pursuing an education or negatively impact student performance (Butcher & Rose-Adams, 2015; Prins, Campbell, & Kassab, 2014). An increasing number of households include either a single parent or two working adults, which also tends to create a greater need for child care (McLennan & Birch, 2005; Prins, Campbell, & Kassab, 2014; Penz, D'Arcy, Stewart, Kosteniuk, Morgan, & Smith, 2007).

Volunteer firefighters require a high degree of altruism to sacrifice their time, and quite possibly their lives, to serve their community (Greene, 2016; Simpson, 1996). According to the National Volunteer Fire Council (2015), volunteer firefighters commonly report that their service to their department limits the time they can spend with their families. Greene (2016) reported that, on average, a volunteer firefighter might donate the equivalent of six 40-hour workweeks per year. Volunteers who quit often cite a lack of time to attend training sessions as a contributing factor (NVFC, 2015).

Technology and Connectivity

The ability to access web-based instruction requires quality digital devices and an internet connection with adequate bandwidth (Hassel & Dean, 2015; Jerin & Rea, 2005). Without access to technology, the knowledge and skills to use it, and the ability to troubleshoot problems, web-based learning may not be an option for many students. Although citizens in much of the U.S. have benefited from faster, higher-capacity internet connections, the infrastructure to support these services often does not exist in rural areas (Kuttner, 2012). Most rural communities of the U.S. lag behind urban and suburban areas in broadband access (Prins, Campbell, & Kassab, 2014; Hassel & Dean, 2015; Whitacre, 2010; LaRose et al., 2007). According to the Pew Research Center (2015), home

broadband use had plateaued and even declined in the years between 2013 and 2015. In January 2015, the FCC set the definition for broadband Internet as connections with download speeds of 25 megabits per second (25 Mbps) or faster. The same year, the FCC reported that 55 million Americans—17 percent of the U.S. population—live in areas unserved by broadband or higher service. Americans living in rural areas disproportionately lack access to high-speed internet services. Only eight percent of citizens living in urban areas do not have access to broadband internet, compared to 53 percent of Americans living in rural and remote areas of the U.S. (FCC, 2015). This not only greatly impedes the ability to have real-time interactions with businesses, educational instructions, and healthcare systems, but also reduces the ability to access videos and other graphic-rich content (Kuttner, 2012; FCC, 2015).

The use of cellular technology offers an alternative for accessing the internet. In 2014, 38 percent of residents in rural areas owned a tablet, which closely mirrored the national average of 42 percent (Anderson, 2015). However, owning a cellular device does not guarantee access to reliable and affordable high-speed internet services (Prins, Campbell, & Kassab, 2014). Rural cellular users may have spotty coverage due to terrain or fewer transmission towers. In addition, people living in low-income households often cannot afford to own a smartphone or they tend to subscribe to low-cost data plans that provide minimal service (Anderson, 2015). Nearly one-fourth of smartphone owners have had to cancel their service for financial reasons (Anderson, 2015). Unfortunately, citizens who heavily depend on their smartphones for online services are often the ones who have the fewest options (Smith, 2015). The success of a web-based education program and the value of online learning hinges on the quality of the learning experience it provides

(Hassel & Dean, 2015; Sprenger, 2002). Accessing video and other media-rich online courses requires a certain quality of computer hardware and software (Smith, 2015). In some cases, those in rural areas who have the greatest issues with connectivity often have the greatest need to participate in online learning (Kuttner, 2012).

Training Needs

Adult workers in rural areas often have different training needs than those performing similar jobs in an urban area. For example, Courtney, Yacopetti, James, Walsh, and Finlayson (2002) found that the training needs of nursing executives varied, depending on whether they were located in metropolitan, provincial, rural, or remote locations in Australia, partly because those in rural and remote areas usually had a wider range of job duties. The same may be true in the fire service—firefighters in rural communities may have different duties than firefighters in an urban setting (Ray, 2012). Given that they face different types of emergencies, rural volunteer firefighters may have little incentive to participate in web-based training if it does not meet their needs.

Training Materials

The rigor of web-based training also can sometimes create a concern. In a 2010 study, Mayes reported that the Amarillo Fire Department (AFD) became aware that the Texas Commission on Fire Protection (TCFP) had been certifying firefighters at the Basic Firefighter level after they had completed a shortened, online version of the training offered from a certain vendor. The AFD did not have a sense for how the online course compared with traditional training. Mayes (2010) investigated whether the online

training was comparable to face-to-face training, as well as the best methods to teach psychomotor skills to adults. Mayes also determined the processes for obtaining certification for both online and traditional students and the policies held by other fire departments concerning the acceptance of online certification training. The results showed that online students spent much less time practicing skills than traditional students. Half of the departments that responded to the survey would not accept that particular online certification training. Because of this study, the AFD ceased to accept applicants who had trained using the vendor's online academy. The recommendations following the study suggested that the TCFP should ensure that online training compares to traditional training in duration and rigor (Mayes, 2010).

Other researchers have raised concerns about the quality of training materials produced by commercial companies. Although fire instructors typically have many years of experience as firefighters, most have not earned degrees in education or related fields. For this reason, and because they have little time, fire service members have come to rely on curriculum produced by textbook publishers. In a 2007 study, Tarr investigated the quality of commercially produced firefighter training materials. According to Tarr (2007), most firefighters train using one particular publisher's curriculum materials, which do little more than outline the chapters and address job performance requirements (JPRs). Fire instructors tend to use these materials off the shelf, meaning agencies rarely take the time to ensure the validity of the content or customize the curriculum to fit their local needs (Tarr, 2007). Milan (2003) expressed similar concerns when he recommended the Golden (Colorado) Fire Department should not solely depend on the published curriculum because it may or may not meet the needs of their department. Both authors

questioned the quality and effectiveness of the publisher's curriculum, as well as its use without formal evaluation at the state or department level.

Instructor Attitudes and Online Teaching Skills

Instructors play a key role in web-based instruction, because the opinions of instructors concerning online courses, as well as their ability to teach in an online setting, can impede or facilitate student learning (Bayne & Ross, 2014; Allen & Seaman, 2012). In their research, Allen, Seaman, Poulin, and Straut (2016) found that a strong relationship existed between the size of the institution and the level of acceptance among faculty members and the number of distance education students at that institution. Leaders of institutions with more than 10,000 students reported that about 60 percent of faculty members accepted online education, while only about a third of faculty at institutions with fewer than 5,000 students had positive views toward online education (Allen et al., 2016).

All types of educational institutions and training agencies face an increasing demand for online courses. However, estimates show that just under a third of educators teach at least a portion of their courses online (Mayadas, Bourne, & Bacsich, 2009). Although this figure may seem encouraging, researchers have argued that the number of instructors who can develop and know how to teach online courses has not kept up with the growing popularity and need for online courses (Lloyd, Byrne, & McCoy, 2012; Rabiee, Nazarian, & Gharibshaeyan, 2013). Lloyd, Byrne, and McCoy (2012) found that more than 80 percent of faculty who had never developed or taught an online course believed that online courses are inferior to traditional courses.

According to Holmgren (2013), fire instructors often report that organizations offer little training on how to facilitate online learning. In the fire service, instructors typically have several years of on-the-job firefighter experience and hold certification for the course levels they teach (Holmgren, 2014b). However, classroom-teaching skills do not automatically translate to an online environment, and assumptions to the contrary can influence the adoption and implementation of educational technology (Holmgren, 2013). As of 2016, National Fire Protection Association (NFPA) standards for fire service instructors do not require training concerning instructional strategies in a web-based environment. Although they may have years of experience teaching in a traditional setting, fire instructors often lack the online teaching skills needed to teach a blended (or hybrid) course. This lack of experience causes them to give priority to traditional teaching methods (Holmgren, 2013). A lack of attention to the web-based component of a training course can result in a poor learning experience. For example, McKay (2012) noted that approximately one-fifth of fire/EMS participants in his study experienced technical difficulties and had problems with procrastination and time management. McKay (2012) attributed many of the issues to inexperienced online instructors who did not provide adequate feedback.

Attitudes of Leaders

Since volunteer firefighters have fewer training options of any kind (web-based or traditional), the attitudes of their superiors toward training also can set an important example. According to the National Volunteer Fire Council (2010), leaders in many volunteer fire departments actively served as firefighters during a time when departments

conducted their own training. Given their years of experience, some of these individuals may not see the need for current training standards. Thus, "…gaining the buy-in of volunteer chiefs and officers regarding the importance of training and certification is critical" (NVFC, 2010, p. 1).

For the present study, knowing whether or not local fire chiefs require participation in web-based courses or if firefighters seek out these training opportunities on their own could have implications concerning motivation for learning. For those in emergency services, course content that does not accommodate the integration of life experiences may not be well accepted (Berg, 2005; Maxfield & Fisher, 2012). In the workplace, assessing the training needs and willingness of adult learners may help predict the likelihood of success (Donavant, 2009). The results of one study reported that only about one-third of potential participants chose to begin a training course when not required to do so (Rossett & Schafer, 2003). However, other researchers have argued that offering voluntary training opportunities—learning for the sake of learning—may prove beneficial. Adults often view mandatory courses as punitive, which may create a barrier to learning (Donavant, 2009). Therefore, training that creates negative attitudes provides little benefit and may be worse than no training at all (Donavant, 2009).

Demographics

Many researchers have argued the importance of considering demographic information when investigating the level of acceptance of web-based learning in a work environment (Somers, 2007; Terra & Ramsay, 2015; Donavant, 2009). In a 2007 study involving emergency medical technicians (EMTs), Somers found that a worker's level of

education, access to computers, and previous experience with alternative delivery methods could predict the acceptance of technology-based instruction. In Somers' study, workers held positive views toward computer-based training (CBT). However, older students were less comfortable with computer-based courses and were less favorable toward the content and course design (Somers, 2007). Somers reported that 44.7 percent of participants had attended less than two years of college, one-fourth had an associate's degree, and one-fourth held a four-year degree. Those with higher levels of education were more comfortable participating in CBT courses. According to Somers (2007), the number of traditionally delivered certification courses may also affect a person's opinion of computer-based training. Somers surmised that, in the past, most EMTs originally worked in blue-collar professions, meaning few had experience using computers in their work environment. Older EMTs were less likely to have experienced web-based delivery during their public school education or professional training (Somers, 2007).

Researchers in other closely related fields have reported similar findings. Donavant (2009) argued that demographic characteristics of law enforcement officers could influence their willingness to participate in online continuing education and training. Studies involving nurses in rural Canada found that those who were middle-aged, worked full time, were unmarried, or had dependents at home were more likely to perceive barriers to continuing education (Penz, D'Arcy, Stewart, Kosteniuk, Morgan, & Smith, 2007).

Theoretical Framework

The work of Everett M. Rogers offers important insight for those advocating new ideas in a social setting (Straub, 2009). While no single theory can adequately describe all humans and each individual's engagement in a learning process, Rogers' *Diffusion of Innovations* (DoI) theory provides a means for studying factors that influence the acceptance of an innovation, such as changes in procedures or new learning technologies, within a community (Straub, 2009; Surry & Farquhar, 1997).

Rogers' theory has its roots in Ryan and Gross' 1943 study of farmers who adopted the use of hybrid corn. Ryan and Gross' analysis was based on research they conducted at Iowa State University (Rice & Rogers, 1980). Over the years, numerous researchers at many universities further refined the work of Ryan and Gross and adapted it to other fields of study (Valente & Rogers, 1995). Rogers became familiar with diffusion theory while studying rural sociology as a graduate student at Iowa State University in the 1950s. In 1962, as a renowned sociology professor at Ohio State University, Rogers published the first edition of *Diffusion of Innovations*.

Since that time, thousands of studies have investigated the adoption of new initiatives by individuals, groups, or organizations. DoI has strongly influenced the discussion related to the acceptance and use of distance education. According to Surry and Farquha (1997), diffusion theory can prove essential in helping educational technologists understand why potential users fail to adopt new products and services. A multitude of reasons could exist and, by studying these factors, instructional technologists can better explain and account for any existing barriers, and thus facilitate the acceptance of the innovation they hope to promote. For the present study, DoI helps explain how

factors such as the attitudes of colleagues, the availability of technology and internet connectivity, and a rural or remote environment influence the adoption of web-based training among volunteer firefighters.

Rogers (2003) described *diffusion* as a process in which members of a social system advocate innovation through a variety of communication channels, such as personal communication or any mass medium (Sahin, 2006). An *innovation* can include a new procedure or tool, or even something familiar used in a new way. Rogers identified four prior conditions for the innovation-decision process. The innovation must:

- Align with *previous practice.*
- Address a *felt need or problem.*
- Encourage a desire for change or *innovativeness.*
- Fit within the *norms of the social system*.

According to Rogers, diffusion is a process with different stages and a person's decision to adopt or reject an innovation occurs at a defined stage (Figure 2-2). A potential adopter becomes aware of the innovation either through existing communication channels or by actively seeking knowledge (Rogers, 2003). A time element helps to define various facets of diffusion of an innovation.

Model of the Five Stages in the Innovation-Decision Process

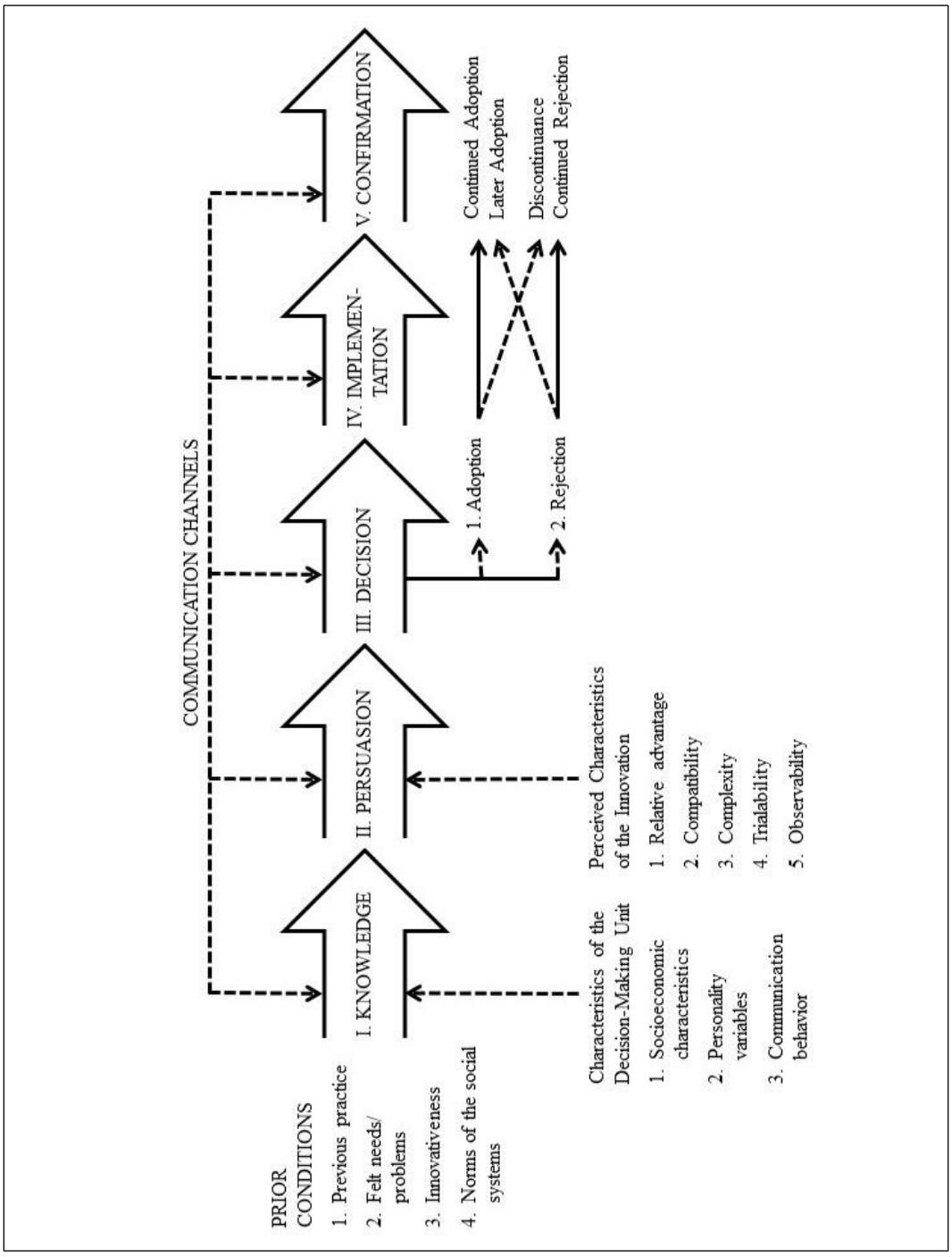

Figure 2-2. Rogers (2003) described the decision to adopt an innovation as a five-stage process that begins when learning about the innovation and ends with its confirmed adoption.

Rogers describes the activities involved with learning about an innovation and making decisions about whether to adopt it as a five-stage process:

1. In the *knowledge* stage, the individual first becomes aware the innovation exists and seeks information about it (Rogers, 2003; Sahin, 2006).
2. At the *persuasion* stage, an individual begins to form positive or negative attitudes and feelings toward the innovation (Sahin, 2006).
3. The *decision* stage marks a point when a person first chooses to either adopt or reject the innovation (Sahin, 2006), although a person may eventually choose to reject the innovation later in the process.
4. The innovation is put into practice at the *implementation* stage, at which time the individual continues to learn about the innovation.
5. At the *confirmation* stage, a person seeks information to support their decision. Use of the innovation may continue or discontinue, depending on the level of support received (Rogers, 2003; Sahin, 2006).

Rogers described diffusion as a process in which members of a *social system* join together to solve a problem to accomplish a common goal. Members of the social system tend to seek information and make decisions about the innovation more quickly than others. Rogers (2003) developed five categories to describe the overall characteristics and values of adopters based on a statistical bell curve. These include:

- Innovators—Those most obsessed with innovation who possess the ability to apply complex technical knowledge (the first 2.5% of the individuals in a system to adopt an innovation).

- Early Adopters—Opinion leaders who follow the lead and advice of the innovators (13.5% of the member system).
- Early Majority—People slightly ahead of the average adopter; this group comprises the next 34 percent of the member system.
- Late Majority—Those slightly behind the average adopter who often approach innovation with skepticism; this group comprises 34 percent of adopters.
- Laggards—A group with almost no opinion leadership; they are near isolates in their social networks, traditionalists, suspicious of change, and often have limited resources (the last 16% to adopt).

Rogers (2003) noted that researchers should not assume any negative connotation from the labels or descriptions of those behind the adoption curve. Rogers did not blame laggards for their situation and stated, "…it is a mistake to imply that laggards are somehow at fault for being relatively late to adopt. System-blame may more accurately describe the reality of the laggards' situation" (p. 285). In all fields of education, training, and professional development and in all types of institutions, some people are slower to adopt an innovation for any number of reasons, and each group requires analysis in context. To use the present study as an example, SCFA did not begin advocating and delivering web-based training until 2010, well after other types of learning institutions, such as higher education and the military, had established computer-based training (CBT) and distance education programs. Thus, for firefighters in South Carolina, web-based training stands as a relatively recent innovation.

In spite of its important contributions to the understanding of human behavior, *Diffusion of Innovations* theory does have weaknesses that researchers must recognize in

order to avoid unintentional prejudice or bias. Rogers (2003) identified four major criticisms of diffusion research. These include:

- Pro-innovation bias—The assumption that the innovation should be adopted at face value.
- Individual-blame bias—The tendency to hold individuals responsible for their situation.
- Recall problem—Respondents' frequent inability to accurately remember when an idea was adopted.
- Issue of equality—*Diffusion of Innovations* theory tends to widen the gap between those at higher- and lower-socioeconomic levels.

Rogers (2003) argued that intellectual criticism facilitates the growth of scientific theory, including the diffusion field. Among his many recommendations for addressing the criticisms of DoI, Rogers (2003) suggested that researchers consider the following strategies when conducting diffusion studies:

- Realize that some individuals should not or cannot adopt the innovations because they may not provide a good option in all situations.
- View the innovation from the perspective of the respondents.
- Avoid siding with the organizations promoting the innovation to the potential users.
- Understand that the usual communication channels may not exist.
- Resist stereotyping those who have yet to adopt the innovation.
- Recognize that innovations diffuse differently in groups with higher and lower socioeconomic status.

- Use purposeful survey methods instead of random sampling.
- Realize that snapshot surveys do little to address causality.

Application of DoI to This Study

This study focuses on the knowledge and persuasion stages of Rogers' Model of Five Stages in the Innovation-Decision Process (Figure 2-2). According to Rogers (2003), the knowledge stage includes three knowledge types:

- *Awareness knowledge* means that users come to know the innovation exists.
- *How-to knowledge* enables users to understand how to use the innovation. Complex innovations require a greater level of how-to knowledge.
- *Principles knowledge* helps develop an understanding of how the innovation works. This type of knowledge enables users to evaluate the effectiveness of the innovation.

Characteristics that define the knowledge stage include socioeconomic characteristics, personality variables, and communication behaviors. For example, those who are more educated or have a higher social status tend to be earlier knowers. However, according to Rogers (2003), "Knowing about an innovation is quite different from using it…" (p. 174), because potential users may know about an innovation but not consider it relevant or useful.

In the persuasion stage, potential adopters form opinions about the innovation. Individuals seek information in mass media and social reinforcement from peers to confirm or disprove initial thoughts about the innovation. Positive or negative attitudes toward the innovation result from the persuasion stage.

Attributes or characteristics of the innovation help reduce uncertainty about its adoption (Sahin, 2006). These characteristics include relative advantage, compatibility, complexity, trialability, and observability. Rogers (2003) argued that the characteristics greatly influence the rate of the adoption of the innovation, with relative advantage being the strongest predictor:

- "*Relative advantage* is the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p. 229). Factors such as cost, incentives, mandates, and the status associated with an innovation can greatly influence the adoption rate.
- *Compatibility* has to do with whether an innovation is "…consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003, p. 240). Incompatibility may exist with values and beliefs, previously adopted ideas, and the needs of the individual or the social system.
- *Complexity* relates to the ease of understanding and using an innovation. Rogers (2003) argued that "…complexity may not be as important as relative advantage or compatibility for many innovations, but for some new ideas complexity is a very important barrier to adoption" (p. 257). For example, most early adopters of computer technology already have a certain level of technical expertise. Those who have less technology experience often are slower to adopt because they must learn about the innovation and the technology at the same time.
- "*Trialability* is the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p. 258). This may include the ability to try an innovation in one's own environment, or the chance to slightly customize the

innovation to meet certain needs. Trialability is particularly important for early adopters, while those who lag behind often rely more on guidance from their peers.

- *Observability* has to do with whether the results of an innovation are visible or easily demonstrated or communicated to others (Rogers, 2003) by role modeling or peer observation (Sahin, 2006).

Relevant DoI Research

In the late 1990s, the internet began a period of diffusion into the general population (Whitacre, 2010). Since that time, hundreds of studies have documented disparities between people who have the opportunities and skills that allow them to take advantage of technology and online resources, and those who do not—a phenomenon known as the *digital divide*. Unfortunately, more than two decades later, this gap continues to exist particularly in rural areas throughout the world, including the United States. Other bodies of research relevant to the present study have to do with the adoption of various educational technologies and other technology-related tools.

Digital Divide

Whitacre (2010) used Rogers' 1962 DoI theory to examine the diffusion of broadband infrastructure and internet access rates in rural Oklahoma between 2003 and 2006. According to Whitacre (2010), internet service providers are less likely to provide broadband services to rural communities because of the lower population densities and the concomitant lack of economies of scale. The study investigated the diffusion of

broadband from a supply-and-demand perspective. Whitacre (2010) found that higher levels of education and having children living in the home led to stronger likelihood of the adoption of broadband. In addition, older heads of household lowered the probability of broadband use. Income levels had less impact on the adoption decision in 2006 than in 2003, although income and education still were the greatest limiting factors. Heads of households with less education were no more likely to adopt broadband in 2006 than they were in 2003, "…which runs counter to diffusion theory" (p. 14). This may have been partly due to the lack of internet infrastructure (Whitacre, 2010).

In 2007, LaRose, Gregg, Strover, Straubhaar, and Carpenter conducted similar research to determine factors that influence broadband adoption in rural areas using the 2003 version of Rogers' DoI theory. As in Whitacre's (2010) study, LaRose et al. (2007) found that age, education, and income level influenced broadband use. However, these researchers argued, "As people gain more information about the Internet and its benefits, demographic variables fade in importance relative to socio-economic ones…" (p. 370). According to LaRose et al. (2007), self-efficacy and expected outcomes were highly influential factors. Before potential users can consider the benefits of broadband, "…they must first believe that they have the ability to use the innovation to achieve those outcomes" (p. 368). This allows users to minimize the perceived risks associated with adoption of complex technologies. The researchers suggested the assistance of family and friends provides an important factor "…between basic Internet experience and understanding the benefits of broadband connections" (p. 371). These researchers also noted that a lack of marketing also presents a barrier to broadband adoption.

Kim (2011) argued that research regarding diffusion of internet technologies documents social change, given technology's impact on socioeconomics. According to Rogers' (2003) theory, the adoption of an innovation typically follows a normal S-shaped curve. The distribution rises slowly at first. The curve steepens sharply until half of the individual systems adopt the innovation, and then the curve flattens as the adoption rate decreases among the remaining potential users. Using the Current Population Survey (CPS) performed monthly by the U.S. Census Bureau, Kim's (2011) analysis showed that the internet adoption rate flattened at around 60 percent in 2001, indicating some groups might not achieve universal adoption. Thus, these results show that a bridge across the digital divide does not appear likely in the near future (Kim, 2011), although a 2015 report from Pew Research Center shows that a growing number of people believe not having access to the internet at home creates a major disadvantage when accessing government services and other information. Kim (2011) argued that improvements in graphical interfaces have made computer devices more user-friendly, but computer skills are cumulative. In addition, a strong need to adopt an innovation remains one of the most important motivation factors. Those with a small social network have less incentive to remain active internet users after they made the decision to adopt it. This study's results also showed that age, gender, education, and race are associated with continued internet use, particularly for young, white, males with higher education levels.

Other researchers, such as Araque, Maiden, Bravo, Estrada, Evan, Hubchik, Kirby, and Reddy (2013), found that although low-income communities and households had less access to technology and the internet, income was not the only factor perpetuating the digital divide. These groups also lacked computer literacy. They also

found that having a computer and an internet connection at home offered several advantages, including not having to travel to the library to use the computer, improved computer skills and knowledge about how to complete tasks such as paying bills online, and the ability to take classes online (Araque et al., 2013).

Adoption of Instructional Technology

According to Isleem (2003), comparatively few studies that use Rogers' theoretical framework relate to the use of instructional computer technology. The following studies provide a means for understanding the potential application of DoI in the present study.

In 2010, Duan, He, Feng, Li, and Fu used Rogers' (2003) theory to investigate the intention of Chinese students to pursue online higher education degree programs. They adapted an existing survey developed by Moore and Benbasat (1991) based on a literature review of innovation adoption studies to gauge user perceptions (Duan et al., 2010). The results of their study showed students would only adopt online learning if they felt it was compatible with their learning needs, life style, and career goals. These researchers argued that providers should educate potential adopters about the benefits of flexibility and compatibility of online learning. Duan et al. (2010) also reported that 35 percent of respondents expressed they intended to use online learning, 26 percent were not likely, and 28 percent were unsure. They recommended further research to investigate why the majority of potential users were unlikely or unsure whether they would adopt online learning.

In a similar study, Tung and Chang (2008) conducted a survey to explore factors that motivated Taiwanese nursing students to enroll in online courses. Using DoI combined with the technology acceptance model (TAM), they found high computer anxiety and tuition costs were often deterrents to the use of online learning. They also found that self-efficacy, belief in the usefulness of online learning, relevant content, ease of use, and compatibility with personal learning strategies provided positive motivation for using online learning. The researchers noted that most nursing students in Taiwan are female, and that only about seven percent of the participants in this study were male. For this reason, Tung and Chang (2008) recommended that future studies should consider gender on the behavioral intentions to use online courses.

Summary

Since the mid-1990s, hundreds of studies have investigated the adoption of distance education. This chapter provided a review of previous research related to the use of web-based training by emergency responders. Early studies by Muilenburg and Berge (2001, 2005) were some of the first to identify common barriers to distance education in a variety of educational settings. However, these early studies did not consider the geographical location of the student, the unique needs of adult learners, or the organizational culture of their work environment.

Framing the discussion of this study using Rogers' *Diffusion of Innovations* theory requires an understanding of the rural fire service. For this reason, this chapter also includes descriptions of fire service organizational culture and training. A review of similar studies based on diffusion theories ensured the consideration of all the major

issues and outcomes relevant to the present study. This information also helped defined a possible list of questions for inclusion in the survey instrument.

Currently, little information exists concerning rural volunteer firefighters' awareness and use of web-based training and whether they feel web-based training can address their training needs. However, the three descriptors—rural, volunteer, and firefighter—provide important clues:

- *Rural* implies that some firefighters and the communities they serve may face certain economic and technological disadvantages.
- The word *volunteer* means that these men and women likely have other responsibilities that place demands on their time, such as family needs and full-time jobs outside the fire service. In addition, high dropout rates present a problem when implementing online training, and attrition rates are even worse when participation is voluntary (Long, Dubois, & Faley, 2009).
- When discussing *firefighters*, one also must consider the unique fire service culture, organizational structure, SOPs, and training requirements that can act as a barrier to change or to the adoption of an innovation.

The next chapter includes a description of the participants in this study and the criteria for their selection. Chapter III also provides an explanation of the research design, schedule, the survey instrument, and other aspects of the research methods.

CHAPTER III

METHODOLOGY

To improve safety and to meet the changing role of emergency workers, many public safety organizations have implemented web-based training programs (Jerin & Rea, 2005). Web-based delivery provides the convenience of 24-hours-a-day, seven-days-a-week access, often with the added benefit of lower administrative costs (Sprenger, 2002). However, the extent to which rural firefighters are aware of web-based training and take advantage of these training opportunities is unknown.

This study investigated the diffusion of web-based training among rural firefighters in the State of South Carolina. Rogers' *Diffusion of Innovations* (DoI) theory provides a framework for discussing the issues facing these participants. This theory enables a researcher to take into account the factors that influence the decisions of individuals to adopt innovations. Although the diffusion model advanced by Rogers has five different stages, the present study focuses on the first two—the knowledge and persuasion stages of the model.

This chapter describes the participants and the criteria used in their selection, the research design, considerations concerning reliability and validity, the process for developing and testing the survey instrument, and the procedures for gathering the data.

Participants

Participants in this study were active, volunteer and career firefighters from departments in five rural counties in the State of South Carolina (Figure 3-1).

Map of the Continental U.S.

Figure 3-1. Location of the State of South Carolina, United States of America.

In 2015, the South Carolina Office of State Fire Marshal reported that 25 percent of the state's firefighters ranged in age from 30 to 39, 24 percent ages 20 to 29, 21 percent ages 40 to 49, and 15 percent ages 50 to 59 (Duncan, email correspondence, 2015). However, these numbers also included civilian workers, such as fire department secretaries and administrators who were not active firefighters, which may have skewed the numbers in older age ranges (Stevens, email correspondence, 2015). For comparison, the national figures indicate volunteers make up 69 percent of U.S. fire service members, most of whom serve communities with a population less than 25,000 residents (NVFC, 2016). White males comprise the vast majority of the firefighter population, with 3.8

percent female, 7.2 percent African American, and 9.4 percent Hispanic (NFPA, 2011). Nationally, firefighters range in age from 16 (Junior Firefighter members) to well over age 60, with the largest percentages ranging from ages 30 to 39 (26.9%), ages 40 to 49 (24.8%), and ages 20 to 29 (20.3%) (Haynes & Stein, 2016). A higher percentage of people over the age of 55 serve as volunteers as compared to career firefighters (McLennan & Birch, 2005).

Participant Selection Criteria

The U.S. Department of Agriculture's Economic Research Service (USDA-ERS) and other government agencies often analyze data on rural America by counties or county-equivalent units, as defined by the Office of Management and Budget (OMB) or the U.S. Census Bureau (USDA-ARS, 2015). Eleven counties in South Carolina meet the criteria for being *rural,* defined as non-metropolitan and non-micropolitan areas according to the U.S. Census Bureau's 2013 data. To select participants for the study, the researcher also applied the South Carolina State Firefighters' Association (SCSFA) Staffing for Adequate Fire and Emergency Response (SAFER) grant selection criteria, which provided a way to determine the areas where the greatest need for additional firefighter training may exist. In 2014, SCSFA received a SAFER grant through the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA). This program provides funding to fire departments and other local, state, and national organizations to help increase the number of trained volunteer firefighters (FEMA, 2016). The SAFER grant identified a list of 11 counties for assistance funding. These counties recorded the same number of structure fires as the remaining 35 counties in the state

(selected counties, 42.06%; remainder of the state, 42.83%). In addition, 18 percent of the state's fire-related fatalities occurred in these counties (Riebe, email correspondence, 2016).

Five of the counties selected for SCSFA's SAFER grant met the U.S. Census Bureau's definition of *rural*. Thus, volunteer and combination fire departments in the following five counties served as research sites: Allendale, Bamberg, Chesterfield, Hampton, and McCormick. Given the selection criteria for the SAFER grant and their rural location, it was assumed fire departments in these counties likely had a greater need for additional training. Figure 3-2 shows the location of the selected South Carolina counties.

A goal of the participant selection process was to reach users and non-users of web-based training delivery. Administering a questionnaire in person provided a way to elicit feedback from firefighters who may be unable to participate in a web-based survey. The SCSFA membership list included active firefighters, along with many contributing members who had not donned bunker gear (put on firefighter personal protective equipment, or PPE) in several years. The high cost of printing and postage ruled out an attempt to contact all rural State Firefighters' Association members, and SCSFA's database system did not provide an option for drawing names of members from the targeted audience for this study. Thus, a targeted, in-person survey seemed to be the only feasible option.

Survey Locations

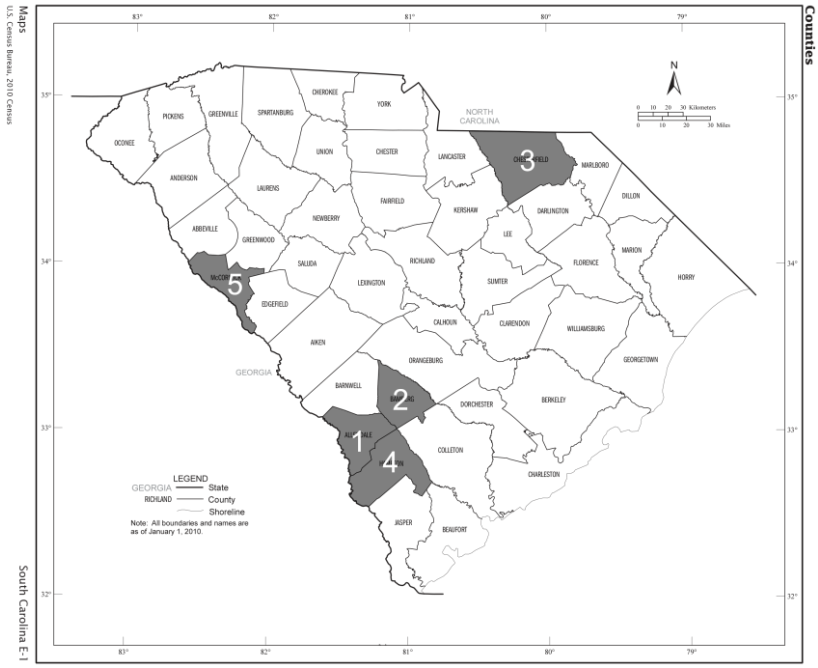

Figure 3-2. Locations of the five rural counties in this study: 1) Allendale, 2) Bamberg, 3) Chesterfield, 4) Hampton, and 5) McCormick. (Map art source: U.S. Census Bureau, 2013.)

The South Carolina Fire Academy (SCFA), the primary firefighter training organization in the state, could not provide detailed information about the target audience. For example, the server analytics from SCFA's learning management system did not provide reliable data for several reasons. SCFA offers many open-enrollment web-based courses, meaning anyone can take the courses without having to register. Student evaluations of online courses included self-reported (and sometimes incomplete) demographic information. The Academy's online training coordinator reported that a substantial portion of the server logs were accidentally lost during a system upgrade

(Simpson, email correspondence, 2016). The Academy also does not release any student records for privacy reasons.

These sampling issues had little bearing on the theoretical frame for this study. Rogers (2003) recommended using purposeful survey methods, rather than random sampling. In addition, other researchers have used convenience samples in exploratory studies, especially when faced with limited funding (Yin, 1989). As in the case of Siegel, Waldman, and Link (2003), the participants represent a sample of convenience, due to familiarity with organizations in the region.

Research Design

This study used an exploratory research approach that consisted of a survey of rural firefighters in selected counties of South Carolina. Stebbins (2001) described exploratory research as a preliminary project that gives way to more studies in the future. This approach allows for flexibility in the procedures (Singh, 2007) and works well when investigating topics on which little or no previous research exists (Brown, 2006).

Edwards and Talbot (1999) compared a survey to an onion, in that the data enables the researcher to peel away some outer layers of the issue of concern. A survey using a questionnaire allows participants to provide feedback under non-intimidating circumstances. Although more expensive than a telephone or internet-based survey, administering a questionnaire in person gives the researcher greater control over the environment (Szolnoki & Hoffmann, 2013), and it results in a greater level of participation from the desired audience (Shuy, 2003). Figure 3-3 provides a visual representation of the design.

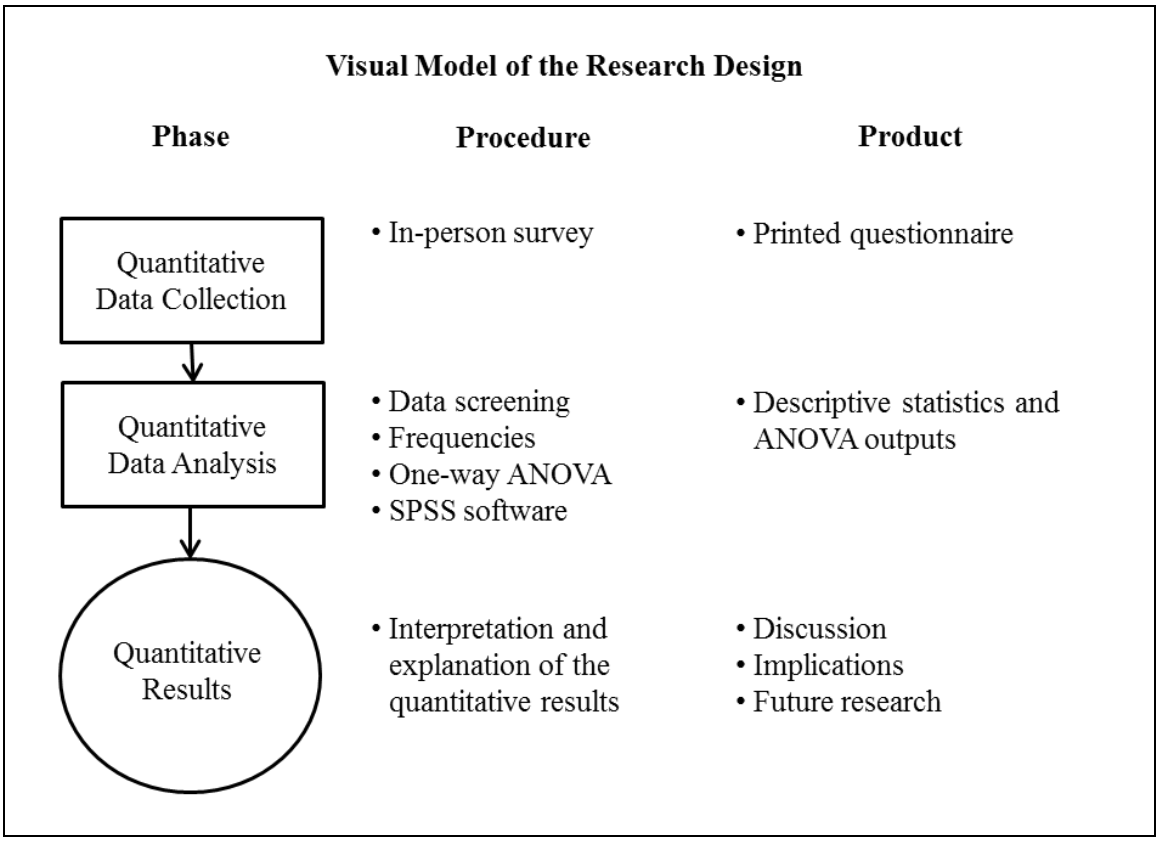

Figure 3-3. Research design for this study.

Reliability and Validity

Research design must address reliability and validity. Reliably refers to the repeatability of a measurement and is categorized by two types—internal and external reliability. External reliability refers to "…the consistency of results between two measures under the same condition over a period of time" (Hsia, 1988, p. 45), while internal reliability refers to the consistency of results between subsamples of the same measure.

In quantitative research, reliability is the extent to which a measure gives the same results when used again under the same conditions (Hsai, 1988). An analysis of the survey instrument following a pilot can indicate the level of internal consistency. In this

case, the Cronbach's alpha test determined the internal consistency estimate of the reliability of the survey results. In addition, the corrected item-total correlation indicated whether questionnaire items in the same set measure the same phenomenon.

Although it may produce repeatable and consistent results, a survey instrument may not be valid (Golafshani, 2003). Validity refers to how adequately an instrument measures what it is supposed to measure (Hsia, 1988) and the truthfulness of the results (Golafshani, 2003). Validity presents a more complex issue than reliability, especially when distinguishing internal and external validity:

- *Internal validity* refers to "…the observed differences attributable to the experimental treatment" (Golafshani, 2003, p. 47). Designing a survey instrument that accurately gathers the opinions of the participants ensures internal validity. A poorly written questionnaire can jeopardize a study's validity if respondents interpret the meaning of the questions differently than what the researcher intended.
- *External validity* refers to the generalizability of the study to the population. The extent to which the data gathered in this study represent the opinions of rural firefighters throughout the state and nation is a matter of external validity. In this case, one cannot automatically assume the generalizability of the findings of this study to members of suburban or urban fire departments. The ability for a respondent to match his or her opinion to answers on a Likert-type scale also relates to external validity.

The term *face validity* describes the validity of quantitative research (Golafshani, 2003), or whether the instrument measures what the researcher claims it measures. The

input of academic, elearning industry, and fire service professionals helped verify the questionnaire in this study would gather data that addressed the diffusion of web-based training among rural firefighters, as framed by DoI. In addition, the analysis of the questionnaire and general feedback following the pilot provided an opportunity to identify possible ambiguities or other validity issues before beginning the actual study.

Research Questions

This study addressed two main research questions. Five supportive questions provided data to answer the main questions:

1. Do rural firefighters in South Carolina know about web-based training?
   1a: Are rural firefighters aware of web-based training opportunities, and are there differences between the levels of awareness by group?
   1b: Which channels of communication do rural firefighters most often use to seek information about training opportunities?
2. Have rural firefighters in South Carolina been persuaded to participate in web-based training?
   2a: Do rural firefighters have favorable opinions about web-based training?
   2b: Do rural firefighters participate in web-based training?
   2c: Do rural firefighters perceive barriers to the use of web-based training?

Description of the Questionnaire

A printed questionnaire served as the primary data source for this study (Appendix A). The researcher could not locate an existing questionnaire that provided an

ideal fit for the research questions, the subjects, and the theoretical frame. However, Bontis (1998) reported that exploratory studies often do not replicate previous instruments. In addition, Rogers (2003) advocates "…creating new scale items for each set of innovations to be adopted by a particular set of individuals…" (p. 225), rather than using an existing instrument developed by other researchers.

Phone conversations with experienced staff members of SCSFA and SCFA concerning their knowledge of rural firefighters in their state provided the starting point for the questionnaire development. Survey instruments by Atkinson (2007), Moore & Benbasat (1991), Wong, Soon, Zed, & Norman (2014), and others provided examples of questions framed in DoI theory. Previous studies that addressed barriers to online learning for adult learners located during the literature review served as important references for identifying potential barriers to web-based training for rural firefighters. Appendix B shows the list of the potential issues that guided the development of the questionnaire items.

The 11-page survey instrument consisted of seven general topics: 1) connectivity and access to technology, 2) social media use and other sources for training information, 3) level of training, 4) training experiences and preferences, 5) opinions concerning web-based fire service training, 6) suggestions for ways to encourage the use of web-based training, and 7) demographics. The instrument contained 50 questions, several of which had multiple parts.

No set standards exist concerning the ideal length for a questionnaire (Leung, 2001; Herzog & Bachman, 1981). Decisions concerning the number of questions partially depend on the audience and their level of interest in the topic (Herzog & Bachman,

1981). However, short questionnaires usually have higher response rates than longer ones (Leung, 2001). Previous studies also recommended placing open-ended questions toward the end of the survey (Burchell & Marsh, 1992). In their study, Herzog and Bachman (1981) noticed that in long sections of a questionnaire that included a list of questions with identical response scales, participants tended to answer all of the questions using a straight-line response, meaning they tended to answer them all the same. For this reason, the instrument used a variety of question types. To encourage responses, 44 of the questions used a structured format that required participants to check a box to indicate their opinion. The six remaining questions asked respondents to write a short answer. Table 3-1 shows the questionnaire topics that addressed each research question. Appendix C shows the complete wording of the questionnaire items organized by research question.

Table 3-1

Topics of the Questionnaire Items by Research Question

Research Question	Questionnaire Item Topic
1. Do rural firefighters in South Carolina know about web-based training?	
a. Are rural firefighters aware of web-based training opportunities, and are there differences in the levels of awareness by group?	Level of awareness of WBT* Demographics
b. Which channels of communication do rural firefighters most often use to seek information about training opportunities?	Sources for WBT information Preferred source Social media use
2. Have rural firefighters in South Carolina been persuaded to participate in web-based training?	
a. Have rural firefighters formed favorable opinions about web-based training?	Five characteristics of the innovation Computer access High-speed internet Frequency of training Types of training received
b. Do rural firefighters participate in web-based training?	Number of WBT courses taken Year of first WBT course SCFA WBT courses taken
c. Do rural firefighters perceive barriers to the use of web-based training?	Possible barriers Main barrier Challenges to widespread adoption Possible motivating factors Main motivation WBT courses needed Ways to increase adoption

* WBT is the abbreviation for *web-based training*.

Section I: Connectivity and Access to Technology

The first page of the survey instrument included a brief description of the study and instructions for completing the questionnaire. Two questions in this section determined whether respondents had access to computers and digital devices and an internet connection at work, the fire station, or at home. Various studies (FCC, 2015; Whitacre, 2010; Araque, 2013) have reported that the presence of fewer internet service providers in rural areas results in fewer citizens having access to a high-speed internet connection, which would prevent respondents from participating in multimedia-rich, web-based courses. Users with limited computer expertise could potentially perceive web-based training as being too complex, and reject it.

Section II: Social Media and Other Information Sources

The second section included four questions concerning social media use and other sources of information about training opportunities. These questions addressed the effectiveness of the state agencies' marketing efforts to promote their web-based courses, as well as determining the channels of communication for reaching potential students. Rogers (2003) and LaRose et al. (2007) have argued that potential adopters cannot be persuaded to use an innovation if they do not know about it. SCFA has regional offices, and SCSFA staff members routinely travel the state. Both SCFA and SCSFA have an active social media presence with a large following, post information about web-based courses on their websites, and often contact fire service members through email blasts. If subjects do not receive the information through the typical communication channels, the diffusion will not spread (Rogers, 2003).

Section III: Level of Training

Two questions in the third section asked firefighters to provide information about their previous training experiences. Somers (2007) reported those with more experience in traditional, lecture-type training courses were less receptive to web-based training delivery. The second question addressed the frequency of training at the department level. The intent of these two questions was to provide an indication of the *actual* need for the adoption of the innovation (in this case, web-based training), according to Rogers' (2003) Model of Five Stages in the Innovation-Decision Process.

Section IV: Training Experiences and Preferences

The fourth section addressed the participants' training experiences and preferred delivery method, which would indicate the state of the innovation-decision process as described by Rogers (2003). Two questions helped define a timeline. SCFA began promoting web-based training in 2010; thus, this date served as the starting point for this survey. A third question asked if participants plan to participate in a web-based training class within the next year.

A four-point Likert-type question asked participants to indicate the degree to which they believed firefighters need continual training, regardless of delivery method. This question addressed the *perceived* need for the innovation. According to NVFC (2010), firefighters with more experience are less likely to see the need for ongoing training.

The next question asked respondents if they have participated in training offered by a selected list of vendors. This list only included training agencies promoted through

the SCFA's social media and website. The last question in this section asked respondents to check a box next to the names of SCFA fully online, hybrid, and blended courses they had completed. Appendix D provides a list of some of the many training agencies that offer online training on a variety of topics related to firefighting.

Section V: Opinions Concerning Web-Based Training

The fifth section included 17, four-point, Likert-type items. These questions asked the extent to which participants agreed or disagreed with statements related to characteristics of the persuasion stage in Rogers' innovation-decision process. Perceived characteristics of the innovation include relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003; Moore & Benbasat, 1991). The researcher contacted subject matter experts (SMEs) to help ensure these Likert-type items addressed each of the five characteristics. The experts were asked to indicate whether they agreed with the category assigned to each questionnaire item, and to suggest an alternative for any they believed were incorrectly assigned. After receiving all responses, the researcher made a few adjustments based on the category the majority had chosen for each item. Appendix E shows the questionnaire items in the respective categories.

Two multiple-choice and two short-answer questions in this section addressed factors that positively and negatively influence the decision to use web-based training. These items also helped determine if firefighters had already made a decision as to whether or not to adopt web-based training.

Section VI: Ways to Encourage the Use of Web-Based Training

Three open-ended questions allowed participants to share their ideas for future training topics or to suggest ways the state training agencies can assist with the training needs of rural fire department members. These questions provided an opportunity to explore the central phenomenon (Creswell & Plano Clark, 2011) and hear directly from the firefighters in their own words. The first question asked about preferred web-based training topics. Rogers (2003) argued that diffusion of an innovation occurs more quickly if the potential adopter has an identified need. Courtney et al. (2002) found that workers in rural areas have different training needs than those in urban areas. If web-based training does not exist on topics rural firefighters need the most, adoption becomes less likely.

The second and third questions asked about factors that may prevent widespread adoption of web-based training and ways to overcome them. These two questions gave firefighters a chance to comment on factors related to the knowledge stage of Rogers' model (such as better ways to publicize training opportunities) or the persuasion stage (such as the need for information about how to access web-based courses). Open-ended questions have the potential to provide rich content or serendipitous findings that could merit further investigation (Hsia, 1988).

Section VII: Demographics

The questionnaire included 10 demographic questions to provide a means of analyzing the responses of the participants by groups. The demographic questions appeared at the end of the survey, in essence, to help avoid participant fatigue. Since

people other than active firefighters (such as administrators, bookkeepers, retired firefighters, or spouses of firefighters) sometimes attend rural fire department meetings, asking their active duty status helped confirm whether all individuals were currently responding to fire calls and, therefore, eligible for participation in this study. The self-identity question reflected categories of race and ethnicity used by the U.S. Census Bureau.

The demographics section also included a question about disposable income. Several researchers have identified income as a consideration in the adoption of an innovation, such as technology (Rogers, 2003; Whitacre, 2010). Survey items concerning income levels tend to have a low response rate (Yan, Jans, & Curtin, 2006). To get around the sensitivity of this topic, organizations such as BankRate ask how respondents would handle an emergency expense (Steiner, 2015). For this question, respondents who would pay for an unexpected bill of $500 or $1000 by taking money from savings or using cash on hand may be more likely to afford technology such as tablets or computers. Moore & Benbasat (1991) argued that "…what might appear 'costly' to one potential adopter, could be 'inexpensive' to another, depending on their relative levels of income" (pp. 194-195). Thus, relative cost has a greater impact on purchasing behavior than actual cost (Moore & Benbasat, 1991).

Closing Section

At the time of data collection, the need for follow-up interviews was unknown. A question on the last page of the survey instrument asked participants to provide their contact information if they were willing to speak with the researcher by phone. However,

as previously mentioned, the results did not merit follow-up interviews. Participants also had the option to register for a drawing for one of 15 $10-cash incentives.

Subject Matter Experts' Review

Two SCSFA staff members reviewed the initial draft of the questionnaire. After completing the first round of edits, a county fire warden for a large fire district in Wyoming agreed to recruit 11 colleagues to review the second draft. These subject matter experts were college-educated, fire service leaders who were familiar with rural fire departments and web-based firefighter training. (Appendix F shows the message sent to the SMEs.) They provided feedback concerning the appropriateness of each question and the questionnaire's format and usability. The third round of reviewers included a web-based course developer, an instructional designer with a master's degree, three doctoral students in educational technology, two retired university faculty members, and two active faculty members knowledgeable in diffusion theory.

Survey Administration

The presence of both SCFA and SCSFA—two well-funded statewide organizations that promote web-based training—made South Carolina an ideal location to investigate the adoption of web-based training among rural firefighters. However, the researcher did not have direct access to the target audience. SCSFA leaders showed interest in the study and offered local assistance. The researcher and SCSFA staff members agreed that response to the survey would be greater if an SCSFA representative assisted with the survey's administration. SCSFA employed a summer intern, who agreed

to complete the necessary Institutional Review Board (IRB) ethics training through Oklahoma State University and attend the survey pilot and five site visits.

Procedures

At each survey session, the intern followed an IRB-approved script (Appendix G), while the researcher was virtually present by phone. Information in the script described the study and provided instructions for completing the printed questionnaire. This information also appeared on a printed page attached to the front of each questionnaire (Appendix A). The instructions explained that removing the information sheet and completing the questionnaire constituted implied consent for participation in the study. After relaying any questions and answers between the researcher and the participants, the intern distributed the questionnaire and allowed approximately 15 minutes or more to complete it.

When gathering the completed questionnaires, the intern stacked the questionnaires separately from the identifying information and placed all materials in a mailing envelope. The day after each meeting, he used the U.S. Postal Service to mail the questionnaires to the researcher. Once received, the researcher manually entered the participants' responses and comments into SPSS software on a Windows-based computer.

Pilot Phase

Pilot studies are an important component of a good research design (van Teijlingen & Hundley, 2002). Piloting a survey instrument and the procedures can help

identify potential problems in the research process (Hsia, 1988) by detecting complicated methods or questionnaire items that are inappropriate or improperly worded. For the present study, the researcher followed guidelines for piloting a questionnaire identified by van Teijlingen and Hundley (2002). These procedures included:

- Administering the questionnaire using the same procedures intended for the main study
- Asking pilot participants to identify difficult questions
- Asking participants to note how long it took them to complete the questionnaire
- Editing any questions identified as being ambiguous or unnecessary
- Shortening the questionnaire as much as possible
- Piloting it again

Before collecting any data, the researcher submitted a formal proposal for this study to the Oklahoma State University Office of Research Compliance (Institutional Review Board) for their review in early June 2016. Soon after receiving IRB approval, a survey pilot took place at a combination fire department near Columbia, South Carolina. The community's population size (7,400), rural location, and mix of volunteer and career firefighters resembled the departments selected for this study.

On the day scheduled for the pilot, lightning sparked a forest fire that required the assistance of members of the local department. Because of these events, many of the firefighters expected to attend the meeting were not present, and only six firefighters completed a questionnaire. The fire chief recommended a second data collection during a training meeting scheduled the following week to allow more firefighters to participate.

Six additional firefighters completed questionnaires at the second session, which resulted in 12 pilot participants.

The SCSFA intern and the researcher were in contact by phone before, during, and after both pilot sessions. The intern followed the survey administration procedures as planned. The two pilot sessions enabled the intern to gain experience working with groups of firefighters, and allowed for last-minute feedback for the researcher. The morning following the second pilot, the intern mailed the completed questionnaires to the researcher, who then entered the data in SPSS software for analysis.

Questionnaire Reliability for the Pilot

The researcher conducted a Cronbach's alpha test on the results the Likert-type items received from the 12 participants during the survey's pilot phase. The Cronbach's alpha test can help determine whether the questions in a survey instrument elicit consistent and reliable responses (Tavakol & Dennick, 2011). The results of the Cronbach' alpha test for the pilot showed a reliability coefficient of .85. Although researchers continue to debate the minimum level of reliability, sources often cite a range of 0.70 to 0.90 as acceptable alpha values (Field, 2013). Nunnaly and Bernstein (1994) stated that .70 may be an acceptable minimum for a newly developed scale, and that research based on established scales should require a minimum of .80. Exceptionally high alpha values could indicate issues such as redundancy (Tavakol & Dennick, 2011).

Along with a Cronbach's alpha, the corrected item-total correlation can indicate whether questionnaire items measure the same phenomenon as others in the set. Ferketich (1991) argued that, for a reliable scale, corrected item-total correlations should range

between .30 and .70; others have stated that a range of .20 to .75 is acceptable.
In this case, the analysis on the pilot data showed that most of the Likert-type items had a corrected item-total correlation between .20 and .75. A negatively worded question that had been reverse coded fell below that range. However, because this correlation did not negatively affect the Cronbach's alpha score, the researcher proceeded with the survey without editing any questionnaire items. Appendix O reports the results of the pilot.

Data Collection Phase

The first survey session in mid-July 2016 coincided with a monthly meeting at a rural department. Upon arrival, the intern learned that a fatal vehicle accident involving two semis hauling hazardous materials had occurred earlier in the day in a neighboring county. Members of several nearby departments assisted at the emergency scene, including those scheduled to participate in the survey. Most of the department members were still working the incident when the survey session was set to begin. Three firefighters attended and filled out a questionnaire.

The second survey session occurred the following evening at an informational meeting at a fire station in a different county. Approximately 40 people attended. However, the group included insurance vendors, fire apparatus dealers, State Department of Forestry instructors and staff, and many others who were not firefighters or members of that department. The intern administered the survey near the end of the meeting. Nine firefighters—half of those eligible—completed the questionnaire.

Three additional survey sessions took place in different locations during the first two weeks of August 2016, and all three sessions went smoothly. The intern could not

determine an exact number of eligible participants at the three remaining meetings. However, he reported that most (if not all) firefighters who attended submitted a questionnaire.

During his travels around the state, the intern observed that some fire departments seemed better off than others did. For example, while some stations consisted of a small metal building with garage bays and a modest meeting room, others were equipped with up-to-date video projectors, multiple large-screen televisions, several computers connected to the internet, and workout rooms with exercise equipment. He reported the better-equipped fire departments also seemed better situated, in that they typically had access to rural water systems with fire hydrants. Figure 3-4 shows a typical fire station in one of the five counties selected for this study.

After receiving the completed questionnaires from all five survey sessions, the researcher entered the responses into SPSS software on a Windows-based computer. The results of the Cronbach's alpha test showed a reliability coefficient of .85, which was the same as the Cronbach's alpha score for the pilot study. This score falls within the range of acceptable alpha values (Field, 2013).

Rural Fire Station

Figure 3-4. A typical fire station in rural South Carolina. (Photo courtesy of Josh Dunn, 2016.)

Data Analysis

The analysis of the questionnaire used in this exploratory study primarily required descriptive statistics, such as frequencies, percentages, and measures of central tendencies for the sample as a whole. Descriptive statistics organize and describe the characteristics of the data set, and they work well to establish "…a historical anchor point that can be used for comparative purposes in future studies" (Salkind, 2004). This study also used simple analysis of variance (one-way ANOVA) to compare differences between the levels of persuasion by age, fire department type (all-volunteer or combination), years of fire service experience, and disposable income. For the

comparisons that revealed significant differences, Tukey tests determined where the differences occurred.

The use of one-way ANOVA relies on a set of assumptions. Violations in these assumptions can lead to a false or misleading analysis. Possible violations include factors such as a lack of independence between or within samples, outliers, non-normality in the entire sample, and unequal population variances. ANOVA compares the means in reference to a normal distribution. With non-normal data, the means do not reflect the central location. The Levene's test determines whether the data meets the assumption of homogeneity of variance. The research design for this study ensured an independent sample. Comparisons between relatively equal-sized groups helped guard against unequal population variances.

The use of descriptive statistics limits a researcher's ability to make inferences about a larger group. However, the researcher realized from the onset that the targeted audience (firefighters in relatively remote, rural areas) represented a unique subset of the South Carolina fire service, and made no attempts to generalize the results.

The analysis of the open-ended questions required the categorization of responses. The researcher first coded the written responses, and then a second person validated the researchers coding practices. This validation process helps to ensure consistency and reliability of the qualitative data (Creswell, 2013). In this case, an instructional designer with a master's degree in education agreed to assist with the coding.

Summary

This chapter describes the participants and the criteria used in their selection, the research design, considerations concerning reliability and validity, the process for developing and testing the survey instrument, and the procedures for gathering the data. Chapter IV reports the findings of the data collection.

CHAPTER IV

FINDINGS

This exploratory study sought to find out whether firefighters in rural South Carolina know about web-based fire service training and if they had been persuaded to use it. The knowledge and persuasion stages of Rogers' *Diffusion of Innovations* (DoI) theory served as the theoretical frame for this study. Rogers described the knowledge stage as a time when a person becomes aware of an innovation, but has not yet learned the details about it. At the persuasion stage, the individual becomes interested in the innovation and seeks information about whether to adopt it.

In this study, volunteer and career firefighters completed printed questionnaires administered at five meetings held in different rural counties throughout July and August, 2016. The survey instrument included seven sections that addressed connectivity and access to technology, sources for training-related information, level of training, training experiences and preferences, opinions concerning web-based fire service training, ways to encourage the use of web-based training, and demographics (Appendix A). This chapter presents the data gathered from this survey. Chapter V presents the analysis.

Demographics of the Participants

Fifty-eight study participants completed questionnaires at the five rural fire department site visits. However, three participants returned questionnaires with only one or two questions partially completed, and they did not provide demographic information. Another respondent identified himself as a non-active firefighter, which disqualified him from participating in the study. Bamford (1992) argued that omitting minimally completed questionnaires and ineligible responses from the analysis reduces the chance of error. Thus, the researcher removed these four questionnaires from consideration. The remaining 54 respondents reported they actively serve as firefighters, meaning they respond to fire calls and other emergencies, rather than assisting the department in some other capacity such as bookkeeping or other administrative duties.

Tables 4-1 and 4-2 present the personal and firefighter-related demographic information for the respondents. Information provided by the South Carolina Office of State Fire Marshal had described rural firefighters as a relatively homogeneous population in terms of race, gender, and education level (Duncan, email correspondence, 2015; Stevens, email correspondence, 2015). Thus, the analysis examined the responses from the sample group using the following four demographic characteristics:

- Age
- Level of disposable income
- Fire department type (combination or all-volunteer)
- Years of fire service-related experience

Table 4-1

Personal Demographics of Respondents (n = 54)

Questionnaire Item	Responses	Percent
Gender	Male	92.6
	Female	7.4
Years of age	20-29	22.5
	30-39	16.8
	40-49	16.9
	50-59	13.1
	Over 60	16.9
	Did Not Reveal	14.8
Race/ethnicity	Caucasian	87.0
	African American	9.3
	Other	3.7
Education level	High school	46.3
	Technical school	16.7
	Some college	11.1
	Associate's or bachelor's degree	24.1
	Did not reveal	1.9
Means for meeting an emergency expense (level of disposable income)	Use cash on hand	42.6
	Reduce spending	13.0
	Use credit or borrow money	20.4
	Did not reveal	24.1

Note. Due to rounding errors, not all totals equal 100 percent.

Table 4-2

Firefighter-Related Demographics of Respondents (n = 54)

Questionnaire Item	Responses	Percent
Actively serving as a firefighter	Yes	100.0
	No	0.0
Department type	All-volunteer	72.2
	Combination	26.0
	Did not reveal	1.9
Firefighter type	Volunteer	77.8
	Career	20.4
	Did not reveal	1.9
Rank or role	Firefighter	22.2
	Fire chief	13.0
	Chief officer	11.1
	Multiple roles	9.3
	Driver-operator	9.3
	Company officer	9.3
	Training officer	5.6
	Other	3.7
	Recruit	3.7
	Firefighter-EMT	1.9
	Assistant chief	1.9
	District chief	1.9
	No rank	1.9
	Did not reveal	5.6
Years of fire service experience	1-4	16.8
	5-9	14.9
	10-14	16.7
	15-19	11.2
	20-29	15.0
	30 or more	18.7
	Did not reveal	7.4

Note. Due to rounding errors, not all totals equal 100 percent.

Results by Research Questions

This section presents the data gathered from the survey instrument according to the research questions. Two main questions addressed the knowledge and persuasion stages of Rogers' DoI. Five sub-questions focused on the two main research questions.

1. Do rural firefighters in South Carolina know about web-based training?

Two sub-questions addressed the first research question. These questions sought to determine the level of awareness by demographic groups and sources for training information.

Question 1a: Are rural firefighters aware of web-based training opportunities, and are there differences between the levels of awareness by group? One survey item addressed this question, in which participants rated their awareness of web-based training (WBT) on a four-point scale. Approximately one fourth (25.9%) of respondents said they actively seek web-based training opportunities, 31.5 percent said they are somewhat familiar with web-based training opportunities, 33.3 percent said they know very little about web-based training, and 9.3 percent said they were not at all aware of any web-based training opportunities (Figure 4-1).

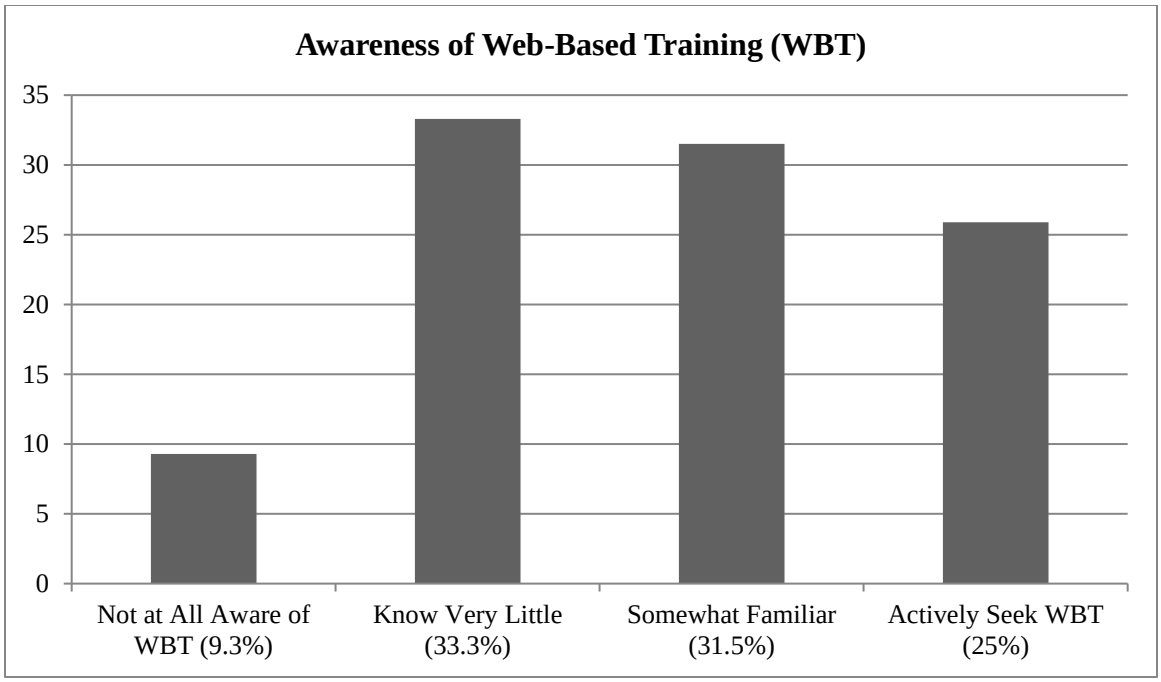

Figure 4-1. Percentages for level of awareness of web-based training opportunities.

Differences in awareness level by age group. The researcher conducted a one-way ANOVA to compare the effect of age on the mean score for awareness of web-based training. Table 4-3 reports the means and standard deviations for the awareness scores. The Levene's score of .838 showed the error variance for the dependent variable was equal across the age groups. The one-way ANOVA showed the effect of age on awareness level was significant at the $p<.05$ level, although the effect was small [$F(4, 41) = 2.798$, $p = .038$, $\eta^2 = .214$] (Table 4-4). Post hoc comparisons using the Tukey HSD test indicated the means for the 40-to-49 age group (M = 2.44, SD = 1.01) and the over-60 age group (M = 1.22, SD = .83) differed significantly. This means that the participants in the 40-to-49 age group had a statistically higher level of awareness than the over-60 age group. No other age group comparison showed a statistically significant difference.

Table 4-3

Frequency, Mean, and Standard Deviation for Awareness of Web-Based Training by Age

		Awareness Level Score	
Age Groups	n	Mean	SD
20-29	12	2.00	.85
30-39	9	1.56	.88
40-49	9	2.44	1.01
50-59	7	1.57	.53
Over 60	9	1.22	.83
Total	46	1.78	.92

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table 4-4

One-Way Analysis of Variance for Awareness of Web-Based Training by Age

Source	*df*	*SS*	*MS*	*F*	*p*	*ES*
Between groups	4	8.11	2.03	2.798	.038	.214
Within groups	41	29.71	.73			
Total	45	37.83				

Note. Levene's score = .838

Differences in awareness level by fire department type. The one-way ANOVA test was used to compare the effect of department type (combination and all-volunteer departments) on the mean score for awareness of web-based training. Table 4-5 shows the means and standard deviations for the awareness level scores. The Levene's test met the assumption for homogeneity of variance. However, the one-way ANOVA test showed the effect of department type on awareness level was non-significant at the 95 percent confidence level [$F(1, 51) = 3.252$, $p = .077$] (Table 4-6).

Table 4-5

Frequency, Mean, and Standard Deviation for Awareness of Web-Based Training by Department Type

		Awareness Level Score	
Department Type	n	Mean	SD
All-volunteer	39	1.61	.99
Combination	14	2.14	.77
Total	53	1.75	.96

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table 4-6

One-Way Analysis of Variance for Awareness of Web-Based Training by Department Type

Source	*df*	*SS*	*MS*	*F*	*p*	*ES*
Between groups	1	2.87	2.87	3.252	.077	.06
Within groups	51	44.95	.88			
Total	52	47.81				

Note. Levene's score = .1

Differences in awareness level by disposable income. The Levene's test indicated the variance of the level of awareness of web-based training was equal across all levels of disposable income. The one-way ANOVA compared the effect of disposable income for three groups, according to how individuals would meet an emergency expense of $500 to $1000. The results showed the effect of disposable income on awareness of web-based training was non-significant [$F(2, 38) = .259$, $p = .773$] (Tables 4-7 and 4-8).

Table 4-7

Frequency, Mean, and Standard Deviation for Awareness of Web-Based Training by Level of Disposable Income

		Awareness Level Score	
Means for Handling a $500-1000 Emergency Expense	n	Mean	SD
Use cash on hand	23	1.91	.90
Reduce spending	7	2.00	.58
Use credit or borrow money	11	1.73	.90
Total	41	1.88	.84

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table 4-8

One-Way Analysis of Variance for Awareness of Web-Based Training by Level of Disposable Income

Source	*df*	*SS*	*MS*	*F*	*p*	*ES*
Between groups	2	.38	.19	.259	.773	.013
Within groups	38	28.01	.74			
Total	40	28.39				

Note. Levene's score = .072

Differences in awareness level by years of fire service experience. The score for the Levene's test met the assumption for homogeneity of variance. The one-way ANOVA compared the effect of years of experience for six levels—1 to 4 years, 5 to 9 years, 10 to 14 years, 15 to 19 years, 20 to 29 years, and more than 30 years. The results indicated the effect of years of experience on the awareness of web-based training was non-significant [$F(5, 44) = .134$, $p = .984$] (Tables 4-9 and 4-10).

Table 4-9

Frequency, Mean, and Standard Deviation for Awareness of Web-Based Training by Years of Fire Service Experience

Years of Fire Service Experience	n	Awareness Level Score	
		Mean	SD
1-4	9	1.67	1.22
5-9	8	1.75	.89
10-14	9	1.78	.97
15-19	6	1.50	.84
20-29	8	1.88	1.13
More than 30	10	1.60	.84
Total	50	1.70	.95

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table 4-10

One-Way Analysis of Variance for Awareness of Web-Based Training by Years of Fire Service Experience

Source	*df*	*SS*	*MS*	*F*	*p*	*ES*
Between groups	5	.67	.13	.134	.984	.015
Within groups	44	43.83	1.00			
Total	49	44.5				

Note. Levene's score = .629

Question 1b: Which channels of communication do rural firefighters most often use to seek information about training opportunities? Three items on the survey instrument related to question 1b.

The first item presented a list of possible information sources, and participants responded by placing a checkmark next to all that they used. The majority of participants (96.3%) said they receive information at fire department meetings. Other important

sources included communication from their fire chief or training officer (74.1%) and the South Carolina Fire Academy website (48.1%). Table 4-11 presents these findings.

The second item asked participants which source they would first consult if they had a question or needed information about web-based training (Table 4-12). More than half (54.7%) said they would first turn to their fire department superior.

The third questionnaire item asked participants to indicate social media platforms they used. The results showed that 66.7 percent of respondents used Facebook, 61.1 percent accessed YouTube, and 50 percent used various phone apps. Thirteen percent of respondents used Twitter (Table 4-13).

Table 4-11

Most Likely Sources for All Types of Training Information (n=54)

Information Source	Percent
Fire department meetings	96.3
Communication from fire chief or training officer	74.1
South Carolina Fire Academy (SCFA) website	48.1
South Carolina State Firefighters' Association (SCSFA) website	29.6
Fire department bulletin boards	24.1
Social media, such as Twitter and/or Facebook	20.4
Communication from SCFA regional office	16.7
Newsletter sent in the standard mail or email	16.7
Other source	3.7

Note. Participants indicated all information sources they used. Thus, the total of the percentages does not equal 100.

Table 4-12

Preferred Source for Training Information (n=53)

Information Source	Percent
Fire department superior	54.7
Internet search	18.9
SCFA or regional staff	15.1
Another firefighter	7.5
Other	3.8

Table 4-13

Types of Media Used at Least Once a Week (n=54)

Social Media	Percent
Facebook	66.7
YouTube	61.1
Phone Apps	50.0
Instagram	16.7
Twitter	13.0
Other	9.3
LinkedIn	3.7
No social media use	11.1

Note. Participants indicated all media types they used. Thus, the total of the percentages does not equal 100.

2. Have rural firefighters in South Carolina been persuaded to participate in web-based training?

Three supportive questions targeted the second main research question. These questions addressed the respondents' opinions of web-based training, participation in web-based training, and potential barriers to its implementation.

Question 2a: Do rural firefighters have favorable opinions about web-based training? Participants in the study responded to a set of 19 Likert-type items, all of which related to the five perceived characteristics of the innovation as described in

Rogers' (2003) DoI theory—relative advantage, compatibility, complexity, trialability, and observability. Reponses were reported on a four-point Likert-type scale, ranging from 1 (strongly disagree) to 4 (strongly agree). Table 4-14 shows the total number of responses, the mean, and the standard deviation for the five sets of Likert-type questions. Appendix E lists the question items according to the five diffusion characteristics.

Table 4-14

Frequency, Mean, and Standard Deviation for the Five Perceived Characteristics of the Innovation

	Persuasion Level Score		
Factors	n	M	SD
Relative advantage	52	2.98	.60
Compatibility	54	3.13	.45
Complexity	52	3.09	.62
Trialability	54	3.18	.62
Observability	50	2.84	1.06

Note. 1 = Strongly disagree, 2 = Somewhat disagree, 3 = Somewhat agree, 4 = Strongly agree.

Additional questionnaire items focused specifically on the complexity and compatibility factors. These research questions examined whether firefighters had access to computer devices and a high-speed internet connection, and whether they participated in face-to-face training. The first item asked participants to indicate if they had access to cell phones, tablets, and computers at their place of employment, the fire station, and at home (Figure 4-2). Appendix H shows the operating systems of the participants' devices. The second questionnaire item asked respondents the likelihood of having access to high-speed internet at these same locations. Figure 4-3 presents the results.

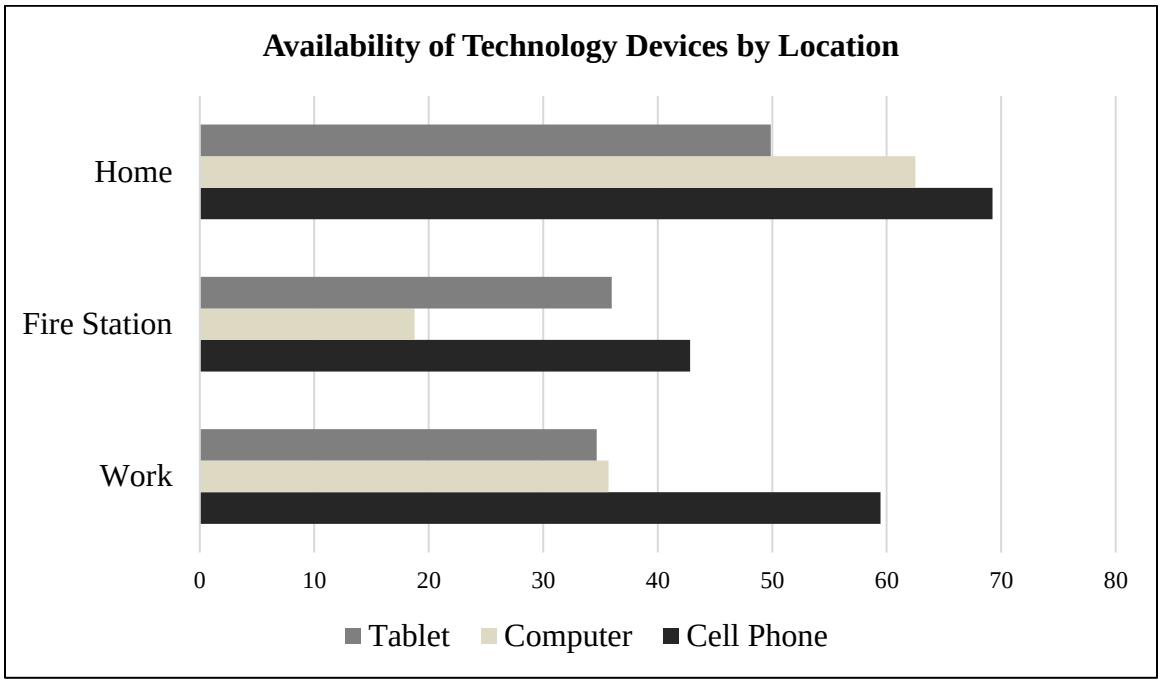

Figure 4-2. Percentage of respondents who had access to tablets, computers, and cell phones by location. Participants indicated all the types of devices available to them.

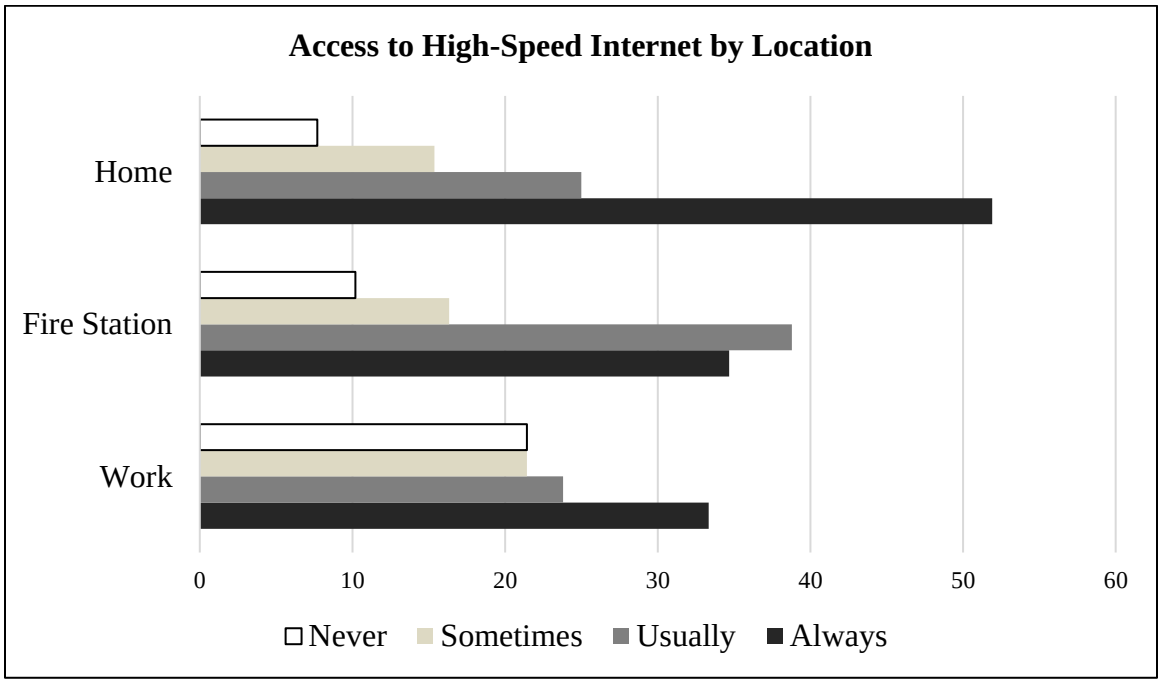

Figure 4-3. Percentage of respondents who had access to high-speed internet by location.

Of those who responded, eight reported having access to a computer or tablet but not a smartphone, and nine had access to a smartphone but not a computer or tablet. In addition, one person only had a smartphone but was not able to watch videos on it, and one person did not have access to a smartphone, computer device, or high-speed internet service.

A third questionnaire item, which addressed compatibility and need, asked respondents if they had received training through their department or other agency. The data showed that 94.4 percent of respondents had received training, and 5.5 percent had not. This item also asked respondents to write down the names of training courses they had taken. Respondents listed 53 course titles. Table 4-15 lists the courses mentioned by five or more participants. The complete list of responses appears in Appendix I.

Table 4-15

Traditional Training Courses Attended by Respondents (n=46)

Training Topics	Frequency
Firefighter I (1153)	24
Firefighter II	16
Fundamentals of Firefighting (1152)	11
Basic Auto Extrication	10
Incident Command System (NIMS-ICS)	10
Pump Operations	8
Fire Instructor I	7
Basic Fire and Emergency Responder (1701)	6
Emergency Vehicle Driver Training	6
Hazmat	5

Note. Many participants provided multiple answers.

A fourth item asked how often respondents participated in training activities conducted by their department. The largest group of respondents (53.7%) said they attended training events two to three times per month; 35.2 percent, once a month; 9.3 percent, every week; and 1.9 percent, three to four times per year.

Question 2b: Do rural firefighters participate in web-based training? Three items on the survey instrument determined whether rural firefighters had used web-based training. The first question asked participants how many fully or partially web-based training courses they had taken since 2010—the year SCFA offered their first course. The results indicated 32.1 percent of respondents had taken three or more web-based fire service training courses; 11.3 percent, two courses; and 17 percent, one course. However, the largest group—39.6 percent of respondents—said they had never taken a web-based training course.

A second item asked respondents the year in which they completed their first web-based course. Again, the researcher selected 2010 as reference point**.** Use began to increase in 2011, rose more sharply, and then plateaued in 2015. Figure 4-4 shows the cumulative growth curve for web-based training for this population. The number of SCFA web-based course offerings increased during this same period. The table in Appendix J lists the titles of the fully online, hybrid, and blended courses and the percentage of respondents who had reported taking them.

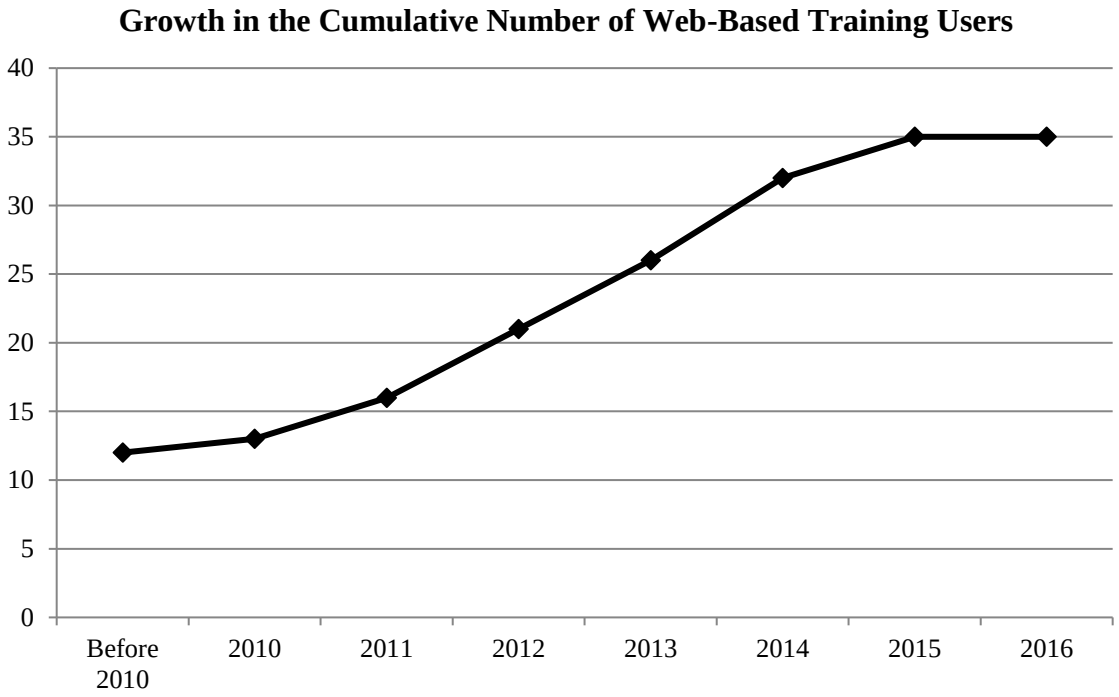

Figure 4-4. The cumulative number of web-based training users by year from 2010 to 2016.

A third item asked respondents which SCFA fully and partially web-based courses they had taken. Table 4-16 shows the SCFA web-based courses completed by more than 10 percent of respondents. Those most frequently mentioned included fully online, self-guided courses. Fewer than 10 percent of respondents had completed a blended or hybrid training course. Appendix J shows the complete list.

Table 4-16

SCFA Web-Based Courses Most Frequently Taken (n=54)

SCFA Courses (and Year Released)	Percent
Fully online	
Hazardous Materials Awareness (2011)	20.4
Emergency Vehicle Response Awareness (2012)	20.4
Emergency Response to Highway Incidents (2013)	18.5
Fire Chief 101 (2014)	18.5
Photovoltaic 101 (2015)	16.7
Improving Tactical Decision Making (2012)	13.0
IFSFI—Thinking Firefighters (2013)	11.1
Have not taken an SCFA web-based course	50.0

Note. Participants indicated all SCFA web-based courses they had taken. Thus, the total of the percentages does not equal 100.

Question 2c: Do rural firefighters perceive barriers to the use of web-based training? Three questionnaire items addressed factors that could impede the adoption of web-based training. In the first item, respondents indicated which of 14 factors listed would likely prevent them from taking a web-based training course. The factor "I learn better in a face-to-face training course" was selected by 38.9 percent of respondents. Of the choices given, 24.1 percent selected "I am too busy to take a web-based course" and an equal percentage "I have children or other family commitments that limit my spare time." Table 4-17 lists the responses indicated by more than 10 percent of participants. Appendix K shows the complete list.

Table 4-17

Factors Most Likely to Prevent Participation in a Web-Based Training Course (n=44)

Factor	Percent
I learn better in a face-to-face course	38.9
I am too busy to take a web-based course	24.1
I have children or other family commitments that limit my spare time	24.1
I probably lack self-motivation needed to complete a web-based course	16.7
I have never seen what a web-based course looks like	13.0
I do not want to spend money on enrollment or other training fees	13.0
I do not have experience taking a web-based course	13.0
I do not have access to a high-speed internet connection	11.1

Note. Participants indicated all factors that applied to them. Thus, the total of the percentages does not equal 100.

The second item asked respondents to write down their main reason for not participating in web-based training. An instructional developer with a master's degree in education worked with the researcher to code the responses. Of the nine responses, four cited poor internet service, three said they preferred courses delivered in a face-to-face setting, one person had no experience taking web-based courses, and one person wrote that they were too busy.

The third item asked respondents to list perceived challenges to the widespread use of web-based training. Participants most frequently cited poor internet service as a main factor. Table 4-18 includes the factors that received more than one mention, and Appendix L shows the complete list.

Table 4-18

Main Challenges to Widespread Adoption of Web-Based Training (n=25)

Challenges	Frequency
Poor internet service	14
No free time	6
No access to a computer	4
No experience with web-based training	3
Unaware that opportunities exist	2

Note. Some participants wrote more than one answer.

Four items helped identify factors that could encourage the use of web-based training. In the first item, respondents indicated which of the 12 factors listed would likely motivate them to take a web-based training course. The responses chosen by more than 10 percent of participants appear in Table 4-19. Top responses include the reduced need for travel (48.1%), convenience (38.9%), and increased training options (37%).

Table 4-19

Factors that Likely Encourage Use of Web-Based Training (n=18)

Motivation Factors	Percent
Web-based learning reduces or eliminates the need to travel	48.1
I find web-based training more convenient than face-to-face training	38.9
I have more options if I use web-based training	37.0
I prefer training that is free or very low cost	29.6
I enjoy learning on my own	25.9
Consistent quality and delivery	13.0
Another firefighter recommends web-based training	11.1

In the second item, participants wrote down the main factor that would motivate them to take a web-based training course. Table 4-20 shows the responses from 26 participants, as coded by the researcher and the instructional developer. Nearly half of

those who responded cited the opportunity to increase knowledge or skills as their main motivation for seeking web-based training.

Table 4-20

Main Motivation for Using Web-Based Training (n=25)

Challenges to Web-Based Training	Frequency
Opportunity to increase knowledge and skills	12
Convenience	8
Reduce the need for travel	3
Increase the number of training opportunities	2

The third item asked respondents to identify the web-based training courses they needed the most. Table 4-21 lists the topics that received more than one mention. Responses indicating the person was unsure or would be interesting in "anything" were the most common. Appendix M shows the complete list.

Table 4-21

Training Topics Needed (n = 28)

Response	Frequency
Don't know	4
Anything	4
Fire behavior	3
Firefighter I and II	3
Auto extrication, hybrid vehicles	2
Basic fire training refresher	2
Executive officer/chief officer	2
Hazmat	2
Structure fires	2
Technical rescue	2

Note. Some participants provided more than one answer.

The fourth question asked respondents their thoughts for increasing the adoption of web-based training among rural firefighters. Table 4-22 lists the responses that received more than one mention. Suggestions included better promotion of training opportunities, installing computers and reliable internet service at fire stations, and having local web-based training experts. Appendix N shows the complete list.

Table 4-22

Ways to Increase the Use of Web-Based Training (n=19)

Response	Frequency
Better promotion of training opportunities	4
Computers available at fire stations	4
Increase access to better internet service	3
Provide computers and internet service at fire stations and/or technology funding	3
Train local experts	2

Note. Some participants provided more than one answer.

Summary

This study sought to determine whether firefighters in rural South Carolina know about web-based fire service training and if they have been persuaded to use it. This chapter presented the participants' demographics and the descriptive data collected to answer these two overarching questions. In addition, this chapter presented comparisons in the level of awareness of web-based training between groups of firefighters, according to age, disposable income, department type, and years of fire service experience. Chapter V discusses the findings and their implications.

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

This chapter begins with an overview of this study, followed by an interpretation of the findings by research question, and a discussion of the results through the lens of Rogers' *Diffusion of Innovations* (DoI) theory. This chapter also includes the implications, recommendations for further research, and conclusion.

Overview of the Study

This study explored the level of awareness and use of web-based training by rural firefighters in rural South Carolina. Specifically, this study sought to determine whether rural South Carolina firefighters knew about web-based training and if they had decided to use it.

The study began with a literature review that identified potential issues that could affect the diffusion of web-based training in the rural fire service. This search helped reveal a wide variety of influential factors, such as:

- The organizational culture of the fire service.
- The historically non-academic nature of the firefighting profession.

- The differences between volunteer and career (paid professional) firefighters.
- Limited access to technology and high-speed internet service in rural areas.

While the literature review revealed a growing interest in the implementation web-based training programs for emergency responders, most of these studies investigated the use of distance delivery systems in metropolitan police departments, fire departments, emergency medical services, and nursing programs. Studies that investigated the knowledge and use of web-based training by rural firefighters seem non-existent. Thus, the present study serves as a foundation for future research to bridge this gap in the literature.

A printed questionnaire served as the data collection source for this study. The list of potential issues identified and discussed in the literature review guided the development of the survey instrument. Questionnaire item categories included:

- Technology use and internet connectivity
- Sources for training information, such as personal communication and social media
- Level of training
- Previous training experience and preferences
- Opinions concerning web-based training
- Ways to improve web-based training delivery for the rural fire service
- Demographics

The questionnaire items also aligned with Rogers' DoI, which served as the theoretical lens for this study. Rogers (2003) described the diffusion of an innovation as a five-stage process, starting at the point when people first becoming aware of an

innovation to their decision to adopt and continue its use. Characteristics of the first two stages—the knowledge and persuasion stages—involve the factors that can influence the initial opinions formed by potential users. These first two stages provide a frame for the discussion of this study's findings.

After academic and fire service experts reviewed the questionnaire and provided feedback, 12 firefighters who served a combination fire department in the outskirts of Columbia, South Carolina, participated in a pilot of the survey instrument. A statistical analysis indicated internal reliability of the questionnaire's Likert-type questions.

Data collection took place during July and August, 2016, at five meetings held at fire stations in different rural counties in South Carolina. When previously compiling information for a federal grant application, the South Carolina State Firefighters' Association (SCSFA) recruitment and retention coordinator had identified several counties as having a disproportionately high number of structure fires and fire-related deaths. The five counties chosen met the criteria for the SAFER grant as well as the definition of *rural,* according to the U.S. Census Bureau. Fire departments in these counties likely had a greater need for additional training opportunities.

The responses from 54 participants comprised the data set for this study. The analysis required the use of descriptive and inferential statistics. The researcher used frequencies, percentages, and measures for central tendencies to analyze responses for the group as a whole, and then by age, level of disposable income, years of fire service experience, and department type. The one-way ANOVA test compared differences between different demographic segments for the level of knowledge of web-based training.

Interpretation of the Findings

Items on the questionnaire addressed two overarching questions: 1) Do rural firefighters in South Carolina know about web-based training? and 2) Have rural firefighters in South Carolina been persuaded to participate in web-based training? Two topics focused on the first main question: knowledge of web-based training by demographic group and channels of communication for training information. Three topics addressed the second main question: opinions concerning web-based training, whether firefighters participate in web-based training, and whether firefighters perceive barriers that limit its use. This section offers a discussion of the data, and it provides an analysis of the results in the context of the knowledge and persuasion stages of DoI.

The Knowledge Stage of the Innovation-Decision Process

Hassinger (1959) argued that people first become aware of an innovation based on a prior need or dissatisfaction with their current situation. They then selectively process messages about the innovation consistent with their attitudes and beliefs. Rogers (2003) stated that innovations also can create needs, and research does not confirm which most often comes first. He also said, in some situations, people might not recognize they have a problem or they may not agree that the innovation can help them, in which case, they would not feel a need to seek information about it.

Potential users cannot form attitudes and opinions about a new idea or innovation if they have no knowledge of it. The knowledge stage, the first stage of the innovation-decision process, is the period in which an individual first learns about an innovation and begins to understand how it works or functions (Rogers, 2003). According to Rogers,

features of the initial decision-making stage include socioeconomic characteristics, communication behavior, and personality variables. Knowing about the demographics of respondents can provide information relevant to DoI theory. Factors such as age, education, literacy level, income, occupational prestige, and social mobility describe an individual's socioeconomic status (Rogers, 2003). In the present study, age, years of fire service experience, department type, and level of disposable income served as the characteristics for comparison.

Question 1a: Are rural firefighters aware of web-based training opportunities, and are there differences in the levels of awareness by group? Overall, the results indicated an extremely low level of awareness of web-based training among the participants, with a mean of 1.78 on a four-point scale for the group as a whole. On this scale, a *1* indicated *not at all aware* and a *2* indicated *knows very little*. The results showed that more than 40 percent of respondents in this study might not know enough about web-based training to form an opinion about it. Only about one fourth said they actively seek web-based training courses. One reason could be that the participants in this study may feel their traditional training options are sufficient.

Differences in awareness level by age group. The reported ages for participants in this study roughly aligned with national averages reported in 2015 by fire service organizations such as the National Volunteer Fire Council (NVFC). According to McLennan and Birch (2005), a higher percentage of people over the age of 55 serve as volunteers as compared to career firefighters, and the results of the present study reflected this as well. Ages of the participants ranged from 20 to 78 years, and ages for individuals in the group showed a flat distribution.

For age, the mean scores for the level of awareness of web-based training ranged from 1.22 for the over-60 age group to 2.44 for the 40-to-49 age group. According to the questionnaire choices, *1* corresponded with *I am not at all aware of any web-based training opportunities* and *3* with *I am somewhat familiar with web-based training opportunities*. The difference between these two age groups was the only comparison that showed a statistical significance. The 20-to-29 age group was the second highest with a mean score of 2.0. The mean of 1.56 for the 30-to-39 age group was the second lowest score and closely matched the mean of 1.57 for those 50 to 59.

A cause for the low mean scores may be a lack of time. Several researchers have argued that adults raising young children often have less free time (McLennan & Birch, 2005; Prins, Campbell, & Kassab, 2014; Penz et al., 2007; Green, 2016). One may speculate that firefighters ages 30 to 39—a group most likely to have children—may be too busy to seek web-based training opportunities. Those in the 40-to-49 age category, the group with the highest mean score, may include more empty-nesters who have fewer family obligations. In general, people over 60 tend to spend less time online than those in younger age groups (Anderson & Perrin, 2016), and this fact may have influenced their level of awareness of web-based courses. Although researchers such as Somers (2007) found that older EMT students were less comfortable with computer-based courses, one cannot make assumptions relative to age and technology use. As Rogers (2003) noted,

> There is inconsistent evidence about the relationship of age and innovativeness. About half of the many diffusion studies on the subject show no relationship, a few found that earlier adopters are younger, and some indicate they are older (p. 288).

Differences in awareness level by fire department type. The results showed that the mean score for the level of awareness of web-based training for firefighters from combination departments was higher than those serving all-volunteer departments. According to Rogers (2003), the size of the unit or organization can influence an individual's knowledge of an innovation. Rogers explained that larger organizations (such as companies or schools) tend to have more resources and wealth. Similarly, Allen et al. (2016) found that leaders and faculty at larger learning institutions reported a higher level of acceptance of online education. In the context of this study, combination fire departments would likely have more resources than smaller, all-volunteer departments. In addition, one could perhaps surmise that career firefighters, who train while on the job, may influence the level of awareness of web-based training among the volunteer members in their department. The results would seem to support DoI theory, although, in this case, the results were not statistically significant.

Differences in awareness level by disposable income. Since people often will not disclose their income to strangers, participants indicated their level of disposable income by choosing a response that best described their means for handling an unexpected expense of $500 to $1000. Even though this question asked about a general level of disposable income and not an exact salary, nearly one fourth of respondents chose not to reveal this information.

The scores for the level of awareness of web-based training were highest for those who self-reported they would reduce spending to meet an emergency expense (Table 4-7). However, the results for all groups indicated a low awareness level. The lowest socioeconomic group (self-reporting they would use credit) had the lowest mean score.

Rogers (2003) argued that earlier adopters have a higher socioeconomic status, which includes such factors as income, standard of living, and occupational prestige. However, since the survey did not determine a specific income level for participants, these results remain inconclusive.

Differences in awareness level by years of fire service experience. The results compared the effect of years of fire service experience for six groups—1 to 4 years, 5 to 9 years, 10 to 14 years, 15 to 19 years, 20 to 29 years, and more than 30 years. The mean scores ranged from the low of 1.5 for those with 15 to 19 years of experience, to the high of 1.88 for those with 20 to 29 years of experience. Length of service may correlate with prestige in the fire service, since younger, less-experienced firefighters often look up to those with a long, well-established career (Levine & Moreland, 1990). In addition, the opinions, actions, and social influences of more experienced members can affect the entire group (Lucas & Kline, 2008). However, in this study, the results revealed low scores for the level of awareness for all groups, regardless of the number of years in the fire service.

Question 1b: Which channels of communication do rural firefighters most often use to seek information about training opportunities? Fire department meetings served as a primary source for training-related information for nearly all respondents (96.3%). Three-quarters of respondents identified their fire chief or training officer as an important source, and approximately half indicated their fire chief was their first choice for training-related information. Approximately 20 percent used social media as a source for information about training opportunities. Of those who indicated they used social media on at least a weekly basis, the results also showed that two-thirds used Facebook,

while relatively few (13%) used Twitter. SCFA and SCSFA staff members use both of these social media platforms and others (such as Instagram) to publicize training opportunities, in addition to posting course announcements on their websites. However, although 66 percent of participants reported they actively use Facebook, only about 20 percent of respondents used social media as a source for information about training opportunities.

Awareness of an innovation can occur through a number of other formal and informal channels of communication. The amount of contact a person has with others—due to factors such as interpersonal networks, travel, exposure to mass media, and level of attachment to a social system—can influence the acquisition of knowledge (Rogers, 2003). Firefighters may become aware of training opportunities from a variety of sources, ranging from direct marketing and social media efforts to personal recommendations from close colleagues. However, paramilitary organizations, such as the fire service, function on a hierarchical command structure (IAFC, 2015). The responses from participants underscore the importance of the fire chief as a gatekeeper for information. For firefighters to be aware of web-based training, fire chiefs must know about these opportunities, and they must communicate this information to the department members.

The Persuasion Stage of the Innovation-Decision Process

The persuasion stage follows the knowledge stage in the innovation-decision process. While the knowledge stage involves the cognitive domain (awareness of an innovation), the persuasion stage involves the affective domain (attitudes toward an innovation). This stage marks the period when an individual begins to understand how

the innovation works or functions (Rogers, 2003). Attitudes formed at this stage lead to possible changes in personal behavior and adoption of the innovation.

Question 2a: Do rural firefighters have favorable opinions about web-based training? During the persuasion stage, selective perception becomes a key factor as an individual begins to form attitudes concerning characteristics of the innovation. Rogers (2003) identified five perceived attributes that can explain the different adoption rates—relative advantage, compatibility, complexity, trialability, and observability. Of these, Rogers argued that the first two—relative advantage and compatibility—are particularly important indicators for adoption.

In this study, participants indicated their opinion about web-based training by rating statements associated with each of these five attributes. Scores were reported on a four-point scale, with *1* meaning *strongly disagree*; *2*, *somewhat disagree*; *3*, *somewhat agree*; and *4*, *strongly agree*. The average scores ranged from 2.84 to 3.18, indicating opinions were slightly more favorable than unfavorable.

Relative Advantage. Before adopting a new way of training, potential users must perceive it as being more advantageous than the previous way of doing things. Factors such as prestige, satisfaction, and convenience can influence an individual's perception of the relative advantage of an innovation. The greater the relative advantage, the faster the rate of adoption.

In this study, the mean score of 2.98 was the second lowest score of the five characteristics, indicating participants were less likely to agree that web-based training offered a relative advantage over face-to-face training methods. For this group of participants, the low mean score for the relative advantage could indicate that the 24/7

convenience and free cost of web-based training may not offset the preference for traditional delivery.

Costs associated with training can create a barrier to its use. However, SCFA's fully online, open-enrollment courses are offered free of charge. A special fund generated from one percent of homeowners' insurance premiums helps fire departments maintain their services. The one-percent funds also subsidize fees for SCFA training courses. This allows the Academy to offer many onsite courses at the low cost of $5 for in-state students (although fees for highly advanced courses, such as aircraft rescue firefighting, can cost hundreds of dollars). Students who take multi-day onsite courses must pay for lodging, meals, and other travel expenses.

Compatibility. An innovation must be consistent with the values, experiences, and needs of potential adopters (Rogers, 2005). The adoption of a new process or idea also must align with the norms of the social system.

A positive relationship exists between compatibility and the rate at which individuals adopt an innovation (Rogers, 2003). The mean score of 3.13 on a four-point scale indicated that participants somewhat agreed that web-based training was compatible with their needs and previous training experiences. In keeping with DoI, potential adopters often recognize a need (such as a need for additional safety training) before seeking an innovative solution (such as web-based training delivery). In addition, those who have previously taken web-based courses are more likely to perceive it as being compatible with their learning preferences (Muilenburg & Berge, 2005). Similarly, firefighters who are familiar with the way web-based training works also may view it as being compatible with the organizational structure and culture of the fire service.

Personal needs influence attitudes formed at the persuasion stage. A strong need to adopt an innovation remains one of the most important motivation factors (Kim, 2011). Individuals will likely reject an innovation if they do not perceive the need for it. Web-based training can increase the number of training opportunities, but firefighters who routinely have access to traditional, face-to-face courses may have less need to seek alternate training options. Information about the level of participation in traditional training can give an indication for the need for web-based training. In this study, the vast majority of respondents (94.4%) reported they received some type of training through their department or state training agency. Approximately 89 percent said they attended department-level training meetings at least once a month. Respondents also listed a wide range of courses they had previously completed and certifications they had achieved. Without feeling a need for web-based training, respondents would have little reason to form opinions about it.

Compatibility with organizational culture becomes a critical factor when advocating new training methods in the fire service. Comradery ensures members work together harmoniously when arriving at an emergency scene (Simpson, 1996). A fire department's biweekly or monthly training meetings help build a social community that facilitates learning. Sommer & Njå (2011) argued that firefighters develop technical knowledge and expertise through storytelling, dinner-table discussions, and other informal conversations. In this way, gathering as a group also strengthens intergenerational relationships by providing an opportunity for long-time members to share knowledge with firefighters who have less experience. Because of the lack of social

interaction, many firefighters may find web-based, independent study courses less satisfying than courses in which students interact with the instructor and their classmates.

Complexity. Complexity relates to the perceived level of difficulty for using or understanding an innovation (Rogers, 2003). A negative relationship exists between complexity and rate of adoption. Likewise, the adoption rate increases when new ideas or processes seem relatively simple.

Before analyzing the results for complexity, one of the question items was reverse coded, meaning that higher scores reflect favorable attitudes toward complexity. The mean score 3.09 on a four-point scale indicated that respondents somewhat agreed that web-based courses could be accessed with little difficulty.

Most of the web-based courses offered by the South Carolina Fire Academy include self-guided, multimedia and video-based modules that require the user to have a reliable, high-speed internet connection. In this study, approximately 52 percent of participants reported *always* having access to high-speed internet service at home and 25 percent said they *usually* did. About thirty-five percent said they *always* had access to high-speed internet at the fire station and 39 percent *usually* had access. This left about one-fourth of respondents rarely or never having access to high-speed internet. For those with a less than reliable high-speed internet service provider, lagging video embedded in web-based courses could make for an unsatisfactory user experience and increase the perceived complexity of web-based training.

For many potential adopters, the use of computer devices may present an additional barrier (Kim, 2011). For example, individuals with little computer experience may become frustrated when having to master the use of their computer device in

addition to learning how to use web-based training. For those who routinely use computer devices, web-based training may be second nature. However, even for proficient technology users who live in rural areas, obtaining access to computers and high-speed internet can add a layer of complexity.

Trialability. Rogers (2003) describes trialability as "…the degree to which an innovation may be experimented with on a limited basis" (p. 258). This includes the ability for individuals to practice using the innovation and experiment with it to determine ways to adapt it to their situation or setting.

In this study, trialability earned an average score of 3.18 on a four-point scale (with a *3* meaning *somewhat agreed* and *4* meaning *agreed*). This score indicated that participants were slightly more likely to believe that they could try web-based training on their own terms. Trialability can help early adopters form favorable attitudes toward an innovation. However, in this case, a lack of computer devices and a reliable internet connection also may affect perceptions toward trialability of web-based training.

Observability. Observability has to do with the visibility of the results of the innovation (Rogers, 2003). In the context of the present study, adoption of web-based training may increase if firefighters observe a colleague using web-based training on a computer or tablet, or if others notice an improvement in performance because of training. Observability received a relatively neutral score. Participants indicated they were more likely to have high-speed internet access at home rather than at the fire station, which would likely reduce observability for other firefighters in the department.

Question 2b: Do rural firefighters participate in web-based training?

Approximately 60 percent of respondents had completed at least one web-based training

course since 2010, the year SCFA began promoting web-based training. SCFA fully online, self-study courses were the most frequently mentioned. Fewer than 10 percent reported they had completed a blended or hybrid course. SCFA offers relatively few blended and hybrid courses, but they host many self-paced courses that allow free open enrollment.

Potential for Future Adoption. As a *process*, the diffusion of an innovation includes a time element. Plotting the accumulated number of adopters over time can determine the level and rate of diffusion within the context of the social system. In this case, the graph resulted in a normal S-shaped curve. The slope began to rise in 2010, shortly after SCFA released its first course. The slope of the curve steepened as more people adopted web-based training, and then began to level off in 2015. The graph showed that about 60 percent of participants had taken a web-based training course by 2016 (Figure 5-1).

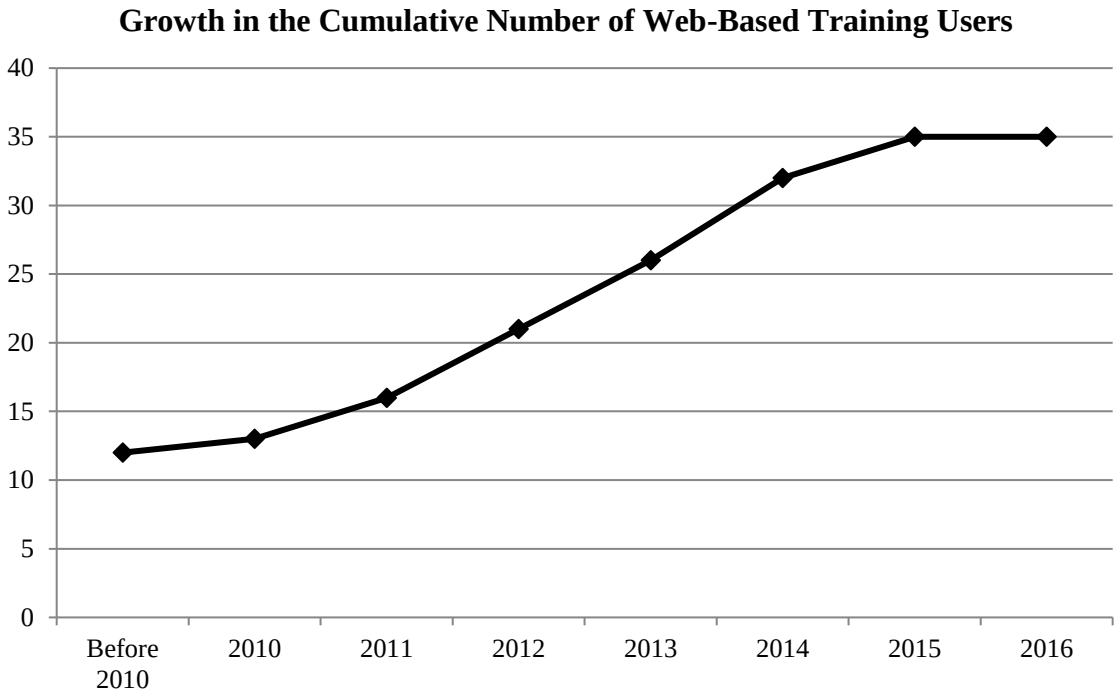

Figure 5-1. The cumulative number of web-based training users by year from 2010 to 2016. (Repeated from Figure 4-4.)

According to Rogers (2003), "…the S-shaped curve describes cases of successful innovation, in which an innovation spreads to almost all of the potential adopters in a social system" (p. 275). The adoption of an innovation results from interpersonal communication. Each new user tells others in their community about the innovation, which produces an initial steep growth in the adoption rate. The adoption curve begins to level off when most of the potential users have adopted the innovation. This occurs because a population cannot grow exponentially. A normal S-curve does not guarantee that an innovation will achieve universal adoption. For example, in Kim's 2011 study, the adoption of the innovation—use of the internet—also flattened at around 60 percent. The snapshot nature of the present study makes it difficult to confirm whether the number of new users reached a plateau.

The idea of *critical mass* becomes important when describing the nature of diffusion of an innovation in a social system. The critical mass defines the point at which enough people have adopted the innovation that the continued adoption rate becomes self-sustaining. This occurs because individual actions often depend on the perceptions of the behaviors of others in the member system (Rogers, 2003). If adopted "…by only a few people in a system, the innovation may ultimately be rejected, so that its rate of adoption levels off and, through discontinuance, nose dives" (Rogers, 2003, p. 275). To ensure the success of web-based firefighter training, academies would need to continue developing new courses, update web-based courses periodically, and advertise existing courses for ongoing refresher training. Otherwise, firefighters would have little incentive to continue using it.

Reasons for Participating in Web-Based Training. Understanding *why* students participate in web-based training can help instructors identify students' needs (Vonderwell & Zachariah, 2014). In this study, firefighters most often cited convenience and the reduced need for travel as reasons for using web-based training. When asked to name the main factor that motivated them, nearly half of those who responded provided answers such as, "the love of learning," "the opportunity to increase knowledge and skills," "learning enjoyment," and other similar statements. Those who serve as volunteer firefighters are typically very interested in the subject. Although serving as a career or volunteer fighter often does not require a college degree, firefighters value ongoing training, formal credentials, and lifelong learning (Coleman, 2006), in part, because firefighters must participate in certification-level training and testing to achieve professional advancements.

Other benefits of web-based training cited by the respondents included increased training options and the ability to receive training at low or no cost. According to Butcher and Rose-Adams (2015), the cost of tuition can hinder participation in online courses. Hassel and Dean (2015) argued that, while rural residents usually enjoy a lower cost of living, rural-based companies typically pay employees lower salaries than urban-based companies do. Thus, costs associated with training may be of greater concern for those living in rural areas. As previously stated, SCFA does not charge a fee for accessing web-based, continuing education courses. Although students in many of SCFA's traditional courses pay a minimal fee of $5, those who take multi-day courses at the Academy also must pay for travel, lodging, and meals.

Question 2c: Do rural firefighters perceive barriers to the use of web-based training? Participants identified several potential barriers to the use of web-based training. Some of the most common responses included a lack of high-speed internet access, a preference for traditional learning, and a lack of free time.

Internet Service. In this study, 14 out of 25 who responded to the question mentioned poor-quality internet service as a main challenge to the wide spread adoption of web-based training. Most rural communities in the U.S. lag urban and suburban areas in broadband access (Prins, Campbell, & Kassab, 2014; Hassel & Dean, 2015; Whitacre, 2010; LaRose et al., 2007). A 2015 FCC broadband progress report stated that 17 percent of the U.S. population lived in areas unserved by high-speed internet, and that Americans who lived in rural areas disproportionately lacked access to these services. It would appear that residents of the rural counties targeted by this study fall into this category. Kim (2011) and others have argued that a bridge across this digital divide does not appear

likely in the near future. Thus, access to high-speed internet will likely continue to be a challenge for rural firefighters.

Learner Preferences. As stated earlier, the average scores for the level of persuasion to use web-based training ranged from 2.84 to 3.18, indicating opinions were slightly more favorable than unfavorable. These scores were reported on a four-point scale, with *1* meaning *strongly disagree*; *2, somewhat disagree*; *3, somewhat agree*; and *4, strongly agree*. The majority of rural firefighters in this sample may simply prefer traditional training methods. Previous studies have identified preference for face-to-face learning as a potential barrier to web-based training (Taber, 2008; Sommer & Njå, 2011; Muilenburg & Berge, 2005; Rabiee et al., 2013).

The results also indicated most participants had a relatively low level of education. Nearly half (46.3%) of the participants had not pursued an education beyond high school, 11.1 percent attended college but did not graduate, 16.7 percent attended technical school, and 24.1 percent completed an associate's or bachelor's degree. Having attended college may increase the likelihood of previous exposure to web-based learning, which would affect perceptions toward ease of use, self-efficacy, and a learner's level of computer anxiety (Galy, Downey, & Johnson, 2011).

Considering the relatively low education level, many in the group may feel they do not study well independently. Holmgren (2013) argued that low-achieving vocational students sometimes struggle to adjust to an online environment, where they must assume a more active role in the learning process. Students may oppose this shift in responsibility if they have little prior knowledge of or previous experience with online learning (Holmgren, 2013).

Busy Lifestyle. In this study, other frequently mentioned barriers included being too busy and having family commitments. According to Terras and Ramsay (2015), students who said they do not have time to learn online often cited life events as a main reason. Butcher and Rose-Adams (2015) found that pressure from having to work more than one job or family responsibilities can negatively impact student performance. This may correlate with the results showing that those in the 30-to-39 age group had lower awareness level scores.

Ways to Increase Participation

Access to Technology. Many participants offered suggestions for increasing the adoption of web-based training in the rural fire service. More than half of the responses related to making computers available at fire stations, providing better internet access at fire stations, and/or offering technology grants. Seminal studies conducted around the turn of the century that investigated distance education identified a lack of computers and technology infrastructure or connectivity as major barriers to online learning (Muilenburg & Berge, 2001), and this digital divide continues to persist (Whitacre, 2010; Kuttner, 2012; Hassel & Dean, 2015; Prins et al., 2014; FCC, 2015; Smith, 2015). SAFER and Fire Act programs and other federal grants (from the USDA, for example) could help rural departments with purchasing computer devices and installing high-speed internet in their fire stations. However, national fire service leaders have expressed concern that volunteer departments may receive less federal funding under the administration that assumed office in January, 2017 (Goldfeder, 2016).

Marketing Efforts. Four of the 19 participants who chose to offer a suggestion for increasing the adoption of web-based training said that more firefighters might use it if it were better publicized. LaRose et al. (2007) also concluded that a lack of marketing presented a barrier to the adoption of technology in rural areas. Since only 25 percent of respondents in the present study reported familiarity with web-based training, better marketing efforts may indeed increase its use. Both SCFA and SCSFA promote firefighter training on their website, in email blasts, and through social media. All of these methods provide a low-cost way to reach a wide audience. The reliance of 46.1 percent of the respondents on the SCFA website for training information serves as a reminder that the Academy should make sure their site contains accurate information. However, given the heavy dependence on fire chiefs and department meetings for information, it is clear that chiefs also fulfill a critical communications and marketing function.

Resident Experts. Two participants suggested identifying a knowledgeable firefighter as the department's resident, web-based training expert. In essence, this suggestion points to the need for what Rogers (2003) described as *opinion leadership*. Opinion leaders are members of the social system who possess technical competence and maintain strong interpersonal communications networks. They also have greater exposure to mass media and have more interaction with those attempting to instill new processes or ideas. Agencies encouraging the adoption of an innovation often must rely on opinion leaders within a system (Rogers, 2003). Opinion leaders understand the dynamics and culture within the organization, and they understand the level of readiness for innovation among the potential adopters (Greenhalgh et al., 2004).

Implications

Given that most participants in this study knew little about web-based training, it makes sense that they held relatively neutral views toward it. This study determined the potential for the existence of barriers to the adoption of web-based training, but it did not confirm what the barriers were or where they occurred. Therefore, one should resist the temptation to focus on one particular group or segment as the cause.

For the fire service, the *division of labor* provides a means for organizing an incident and breaking it down into smaller tasks. This prevents duplication of effort and assigns responsibility to each member to ensure a successful outcome of the mission (IAFC, 2014). Implementing a new statewide training system requires a similar coordinated effort. Such an undertaking has implications for all stakeholders. Training agencies, fire chiefs, instructors and training officers, and fire department members all bear a certain level of responsibility.

Implications for Training Agencies

Communications. The results of this study showed that nearly all respondents relied on the chief for training information, which underscores the need for state agencies to ensure chiefs and field staff stay informed, and that chiefs communicate information to their department members. This also likely requires maintaining communication with other key organizations, such as the state fire service instructors' and chiefs' associations. Increased marketing efforts targeted at instructors, chiefs, and other opinion leaders about the benefits of web-based training could strengthen support for its use.

The high cost of postage and the fact that the Firefighters' Association mailing list includes nearly 18,000 members (J. Pope, Twitter correspondence, April 13, 2017) makes direct mailings impractical. For this reason, state agencies should continue the use of email messages, electronic newsletters, and social media (particularly Facebook) to publicize training, and they should repeat messages multiple times. Websites should include up-to-date information.

The lack of a reliable high-speed internet connection, preference for face-to-face learning, and limited free time deter many potential users from adopting web-based training. Approximately 26 percent of respondents had intermittent or no access to high-speed internet at the fire station. State agencies might consider researching high-speed internet options for rural areas of the state, such as cellular hot spots, wireless ISPs, or satellite internet providers. Funding technology could help alleviate this situation. State training agencies should investigate the availability of rural development or technology grants to assist departments with their technology needs.

Alternative Training Formats. At present, all of the fully web-based courses offered by SCFA include video and other multimedia elements. While rural firefighters can and do participate in these types of courses, students with poor internet service often experience technical problems, which can reduce learner satisfaction (Howland & Moore, 2002). For this reason, training agencies should consider additional formats for web-based delivery to supplement multimedia course offerings. Agencies also should ensure learners can access and complete web-based courses when using a mobile device.

Podcasts (downloadable digital audio recordings) provide a low-cost way to deliver lectures for students who have limited use of the internet. Podcasts ranging from

10 to 30 minutes in length allow greater flexibility than audio and video streaming. Students can download the podcasts and then listen to them while commuting to work or performing chores around the house. Supplemental study guides or fact sheets saved as PDFs could accompany podcasts that require illustrations or additional information. Transcriptions of audio or video files would benefit those who prefer to read the information or those who have difficulty understanding the audio. In some cases, Americans with Disabilities Act (ADA) regulations may even require that training providers offer transcripts of audio files and closed-captioning for videos.

Participants in this study had little experience with blended learning, likely because the state's training agency has offered these types of courses much less frequently than self-guided, multimedia web-based courses. Increasing the use of blended training—where the instructor has a synchronous or asynchronous presence in the online classroom—may encourage participation in web-based learning among those who prefer to interact with other students rather than a computer. Button (2014), Miller (2014), and others have argued that courses that leverage the strengths of both online and traditional instruction hold a lot of promise. Several NFA Executive Fire Officer (EFO) applied research projects (ARPs) also support the use of blended fire service training (Byrd, 2011; Howard, 2009; Rodgers, 2005). This suggests that blended or hybrid courses that facilitate asynchronous instructor-to-student and student-to-student interaction and place less emphasis on multimedia elements could work well for rural firefighters.

Blended learning also supports the social community of a fire department. In many respects, becoming a member of a rural fire department is comparable to joining a social club. For firefighters, group training helps build comradery. Blended learning

allows firefighters to work together and maintain the social aspects of learning. A regional or statewide blended course would allow rural firefighters to expand their learning community beyond their local department.

The successful implementation of blended training requires that instructors know how to facilitate a web-based course. Otherwise, instructors may not feel qualified to teach online or they may tend to replicate their traditional teaching practices in an online classroom (Holmgren, 2014a). Offering a web-based course on how to teach blended training would to provide an opportunity for instructors to learn by example.

Implications for Rural Fire Chiefs

As previously mentioned, the vast majority of participants (96.3%) said they depended on department meetings as a source for information. A large group (54.7%) viewed the fire chief as their preferred source for training information. As an important conduit for information, fire chiefs have an obligation to keep abreast of training opportunities and to discuss these options with the department's members. Maintaining open communication with state agencies helps ensure these organizations are aware of the training and technology needs of the local departments. Fire chiefs also should keep email lists up to date and maintain social media accounts (such as a private Facebook page) as low-cost ways to communicate with department members.

For rural fire stations without internet connectivity, department leaders should investigate the feasibility of installing high-speed internet. If the department lacks computers and other devices and has a limited budget, fire chiefs might consider soliciting donations for new or good-quality used desktop computers, laptop, or tablets.

Implications for Training Officers

On average, participants in this study were only slightly more favorable toward web-based training than unfavorable. One cannot expect a group to have much enthusiasm toward something they know little about. A few respondents suggested that identifying a person within the department who could provide assistance with web-based training might increase its adoption. Training officers would be a likely candidate to fill this role.

Training officers also might consider scheduling evenings for department members to come to the station to work through web-based training as a group. In departments without computers, firefighters could bring their own devices, and the training officer could ensure members understand how to access the learning management system, log in, and self-enroll in a web-based course.

In addition, training officers should inquire about the availability of blended and hybrid courses for their department members. Instructors should learn strategies for facilitating online courses to help ensure student satisfaction (Holmgren, 2013; McKay, 2012). Also, by enrolling in a blended or hybrid course as a student, instructors develop an understanding for the needs of online learners.

Implications for Department Members

Firefighters have a responsibility to stay informed about training opportunities by following state agency and local department social media and periodically checking the websites of these organizations. Offering feedback after taking web-based courses can

help ensure training agencies offer information relevant to the needs of rural firefighters. Most importantly, firefighters must make the time to participate in training.

Recommendations for Further Research

The outcomes of this study and the literature search helped identify several options for future research. As noted in the literature review, previous authors found that research related to fire service curriculum materials (Tarr, 2007) and web-based training for firefighters (Holmgren, 2014) are nearly non-existent. Instead, academic research targeting firefighter training often deals with administrative issues, leadership-related topics, and firefighting strategies and tactics. Studies involving the cognitive and affective training for rural or volunteer firefighters seem exceptionally rare.

Longitudinal Study

Conducting a study similar to the present one that involves firefighters from the same rural areas would better establish the time element for the diffusion process. The adoption curve for web-based training in this study showed the accumulation of new users had leveled off in recent years. However, the present study captured only a moment in time. A longitudinal study would help identify trends and determine whether the number of web-based training users has reached a critical mass.

Preferred Method of Training Delivery

While the responses suggested participants preferred traditional training methods, the results were inconclusive. A questionnaire item asked respondents to rank five

different instructional delivery methods 1 through 5 according to personal learning preferences. The choices included face-to-face traditional instruction, web-based with instructor interaction, web-based with no instructor interaction, blended or hybrid learning, and "it depends on the situation." The researcher omitted the results from the formal analysis, because of apparent confusion concerning the instructions for answering the question.

A study concerning the learning preferences of rural firefighters merits investigation. Luedtke (2009) reported that computer-based training with no interaction between students and the instructor received poor reviews among firefighters in two Wisconsin fire departments.

Training Needs

A follow-up study should closely investigate what type of training takes place at local departments. Although a questionnaire item asked respondents to list the types of training they had received, it appeared participants disagreed as to what constitutes local, state, and national certification-level training. Because rural volunteer firefighters generally have fewer resources overall (NVFC, 2010), they often have less training and practical experience than those who serve departments in larger communities. Consistent with Meyer (2003), anecdotal information from firefighters has shown that at small, rural fire departments activities such as making equipment repairs sometimes take priority over training. In other words, because of time limitations, short-term mitigation (having equipment that functions properly) sometimes supersedes a long-term mitigation (e.g., training to be able to assess unusual, yet hazardous, situations). Knowing about the

training offered by local departments would better define the need for supplemental training.

Optimal Instructional Design

The literature search did not locate research that investigated optimal instructional design considerations for developing quality, web-based, firefighter training. State-level training developers often follow the lead of publishing companies (Milan, 2006) whose writers or contractors may or may not fully understand the needs of the audience. Future research could investigate the mix of instructional design elements that constitutes the most effective web-based training for awareness-, technician- and operations-level training.

Barriers to Web-Based Training

A detailed analysis of barriers to web-based training was beyond the scope of this study. However, the literature review identified a list of potential barriers that merit further investigation.

Holmgren (2012, 2013, 2014a, 2014b, 2015) has conducted numerous studies related to fire service training in Sweden in which he described barriers to training delivery using the framework of Activity Theory. In the context of the present study, the Activity Theory model can enable an understanding of how factors such as the attitudes of colleagues, the availability of resources and equipment, training standards, fire service culture, a busy lifestyle, and a rural or remote environment influence the adoption of web-based training among rural firefighters in the U.S.

Effectiveness of Web-Based Training

A future study could investigate the level of learning outcomes of web-based fire service training. Other researchers have found that the effectiveness of web-based firefighter training sometimes comes under question (Mayes, 2010; Tarr, 2007; Milan, 2003). Research is needed that compares student performance in traditional, fully online, and blended classes. One way to measure instructional quality would be to assess the results of the final exam of students in all three settings. A follow-up exam after a determined time would allow a researcher to compare the students' knowledge retention for each of the three delivery methods.

Readability of Web-Based Training

Future research also could involve the readability of materials used in web-based training. Manuals and other resources used to train personnel should be similar to the complexity of materials they must read and understand in the workplace (Payne, 1976). Holmgren (2013) argued that firefighters who are not good students sometimes struggle in an online environment. Performing readability tests (such as the Flesch Reading Ease or Flesch-Kincaid Grade Level tests) on the content of web-based courses would help ensure instructional materials align with the reading comprehension levels and learning preferences of firefighters. Payne (1976) described the methods used in a similar study involving firefighters at a Washington, D.C. fire department. The results of Payne's readability tests revealed training manuals had a grade 14 reading level (or junior college level), and the materials were described as "difficult."

Conclusion

Each year in the U.S., an average of 80 or more firefighters die because of accidents or injuries that occur at emergency scenes. In many cases, investigators cite lack of training as a contributing cause of death. Rural firefighters, who often have less time for training and fewer resources than those who serve urban and suburban fire departments, seem particularly at risk.

In recent years, an increasing number of state-level agencies have begun offering web-based training, in part, to help meet the needs of firefighters in remote areas. Online delivery offers the added advantages of being cost effective for training academies and affordable for students. Thousands of firefighters have accessed web-based training courses and curriculum materials offered by the South Carolina Fire Academy and South Carolina State Firefighters' Association. Yet, the majority of the rural firefighters in this study had not yet fully embraced web-based learning. Many simply did not know enough about web-based training to form an opinion about it.

Those who live in rural areas often have less experience with online learning, fewer communication channels, additional time constraints, and limited access to high-speed internet. Because of these barriers, a digital divide continues to persist for rural learners, including firefighters. The fire service remains relatively homogeneous in terms of demographics; however, rural firefighters represent a unique subset. Although many web-based training systems increasingly rely on the use of videos and multimedia animations, training agencies should resist the "one media fits all" delivery approach when implementing web-based training programs, and consider additional ways to use technology and the internet to meet the unique training needs of rural firefighters.

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APPENDICES

Appendix A

Survey and Participation Consent Information and Questionnaire
Oklahoma State University

PROJECT TITLE— The Awareness and Acceptance of Web-Based Training by Rural Firefighters (Dissertation Research Survey)

INVESTIGATORS—

- Margi Stone Cooper: PhD Candidate; Oklahoma State University
- Dr. Tutaleni I. Asino: PhD; Dissertation Committee Advisor; Oklahoma State University

PURPOSE—This study seeks the opinions of rural volunteer firefighters concerning web-based training.

PROCEDURES—You will complete a 50-item printed questionnaire with sections on several topics related to web-based training, as well as demographics. It will take approximately 15 minutes to complete this questionnaire. If the survey reveals unexpected results, the researcher may conduct a 15-minute phone interview with several participants to help clarify the findings of the survey. The phone calls will be audio recorded and transcribed. If you are willing to speak with the researcher by phone, you may provide your contact information on the last page of the questionnaire. This page will be detached from the questionnaire to ensure anonymity.

RISKS OF PARTICIPATION—There are no known risks associated with this project that are greater than those ordinarily encountered in daily life.

BENEFITS OF PARTICIPATION—You will receive no direct personal benefit by participating in this research. However, this study may provide information for the South Carolina State Firefighters' Association to help plan future training initiatives.

CONFIDENTIALITY—The records of this study will be kept confidential. Any written results will discuss findings of the group as a whole and will not include information that will identify you. Research records will be stored on a password protected data storage drive in a locked office and only researchers and individuals responsible for research oversight will have access to the records. Data will be destroyed three years after the study has been completed. Audio recordings will be transcribed and destroyed within one week of the interview.

COMPENSATION—Survey participants may provide their contact information for a chance to win one of 15 $10 cash prize, which will be awarded after the researcher receives all names of study participants at the conclusion of the survey period. Winners will be selected in a combined random drawing and notified using the contact information they provided. The 15 cash awards will be sent through standard mail. No others will receive compensation for completing the questionnaire or participating in a phone interview.

CONTACTS—You may contact either of the researchers at the following email addresses, should you desire to discuss your participation in the study and/or request information about the results of the study:

- Margi Stone Cooper, Stillwater, OK 74075, flyingc@okstate.edu; or
- Dr. Tutaleni Asino, Oklahoma State University, Stillwater, OK, 74078, tutaleni.asino@okstate.edu

If you have questions about your rights as a research volunteer, you may contact the IRB Office, 223 Scott Hall, Oklahoma State University, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu.

PARTICIPANT RIGHTS—I understand that my participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time, without penalty.

CONSENT DOCUMENTATION—I have been fully informed about the procedures listed here. I am aware of what I will be asked to do and of the benefits of my participation. I also understand the following statements:

- I affirm that I am 18 years of age or older.
- I have read and fully understand this consent form.
- I understand that completing the attached questionnaire constitutes consent to participate in this survey.
- I may keep this copy of the survey information sheet for my own use.

RURAL FIREFIGHTER SURVEY

Thank you for agreeing to participate in this study. This survey is part of my dissertation research, which focuses on training for rural firefighters. Participation in this study is voluntary. However, I want to hear from you. Your input may benefit firefighters across the state—and, quite possibly, across the nation!

Please answer all the questions. The questionnaire will take about 15 minutes to complete. I will not report any answers as coming from you, so please give your honest opinions. For this survey, *web-based training* means a course in which firefighters complete one or more portions using a computer or device connected to the internet.

Thank you for your assistance!

—Margi Stone Cooper, Ph.D. Candidate at Oklahoma State University

SECTION I: Tell us about your connectivity and access to technology.

1. Which of the following types of technology do you use regularly at work, at the fire station, or at home? (Check <u>all</u> boxes that apply.)

	I use at work	I use at the fire station	I use at home	I do not use
iPhone	❒	❒	❒	❒
iPad	❒	❒	❒	❒
Android phone	❒	❒	❒	❒
Android tablet	❒	❒	❒	❒
Windows tablet	❒	❒	❒	❒
Windows computer or laptop	❒	❒	❒	❒
Mac computer or laptop	❒	❒	❒	❒
Other (specify): _____	❒	❒	❒	❒

2. Which of the following describes your place of employment (Check only <u>one</u> answer.)

❒ I am employed at the fire station.
❒ I am employed at a business, school, or other type of agency.
❒ I work at home, or I am retired.

3. At which locations can you watch videos on the internet using a computer, tablet, or phone without the media periodically freezing up? (Choose only one response for each location.)

	Always	Usually	Sometimes	Never	No internet access at this location
At work	❒	❒	❒	❒	❒
At the fire station	❒	❒	❒	❒	❒
At home	❒	❒	❒	❒	❒

SECTION II: Tell us about your social media use and sources for information.

4. Which of the following types of media do you use at least once a week? (Check only those that apply to you.)

❒ Facebook
❒ Twitter
❒ LinkedIn
❒ Instagram
❒ YouTube
❒ Smartphone apps
❒ Other (please specify): _____
❒ None of the above

5. Through which sources are you most likely to find out about fire service training opportunities (web-based and face-to-face courses)? (Check all that apply to you.)

❒ Fire department meetings
❒ Fire department bulletin boards
❒ Communication from the fire chief or training officer
❒ Communication from the regional office
❒ Social media, such as Twitter and/or Facebook
❒ South Carolina Fire Academy website
❒ South Carolina Firefighters' Association website
❒ Newsletter sent in the standard mail or email
❒ Other (please specify): _____
❒ None of the above—I never hear about fire service training opportunities

6. To what extent are you aware of web-based fire service training opportunities? (Choose only one answer.)

❒ I actively seek web-based training courses and take them whenever possible
❒ I am somewhat familiar with web-based training opportunities
❒ I know very little about web-based training opportunities
❒ I am not at all aware of any web-based training opportunities

7. If you have a question about web-based training in general, where do you first turn for an answer or opinion? (Choose only one answer.)

   ❒ South Carolina Fire Academy or regional staff
   ❒ South Carolina State Firefighters' Association
   ❒ My fire department superior
   ❒ Another firefighter in my department
   ❒ Internet search
   ❒ Other (please specify): _____

SECTION III: Tell us about your level of training.

8. Have you received fire service-related training, either through your local department, statewide agency, or a national organization?

   ❒ Yes ❒ No

   If you answered yes, please indicate the names of the courses for the training you have received. For each type of training below, list up to three courses in the spaces provided, or write "none" if this does not apply to you. (You only need to list your highest qualifications. For example, if you hold Firefighter I and Firefighter II certification, you only need to list Firefighter II.)

   A. Types of training through my department:

   _____ _____ _____

   B. State-level training certificates:

   _____ _____ _____

   C. IFSAC (NFPA) certifications:

   _____ _____ _____

   D. National Fire Academy credentials:

   _____ _____ _____

9. How often do you participate in face-to-face training activities conducted by your department? (Choose only one answer.)

   ❒ Every week
   ❒ Every other week
   ❒ Once a month
   ❒ Every other month
   ❒ Three or four times a year
   ❒ Twice a year
   ❒ Once a year
   ❒ Less than once a year
   ❒ Never
   ❒ Other (please specify): _____

SECTION IV: Tell us about your training experiences and preferences.

10. Which of the following course formats best suits your personal preferences to receive fire service training? (Rank the following 1 through 5, with 1 being the most preferred and 5 being the least preferred training method.)

    _____ A course taught in a traditional, face-to-face setting

    _____ An independent study course where I learn using a computer, do not have to attend any class sessions in person, and do not interact with an instructor or other students

    _____ A web-based course where students interact with the instructor through email, web discussions, or live chat sessions, but does not include face-to-face sessions

    _____ A blended or hybrid course, which includes both online learning and face-to-face sessions that address major concepts or skills

    _____ It depends on the situation; for example, a web-based course for refresher-type information and a blended or face-to-face course for new skill acquisition

11. How many fully or partially web-based fire service training courses have you taken since 2010? (Choose only one answer.)

    ❒ 0 ❒ 1 ❒ 2 ❒ 3 or more

12. If you have participated in web-based fire service training in the past, to the best of your recollection, in what year did you take your first course? (Check only one answer.)

❒	❒	❒	❒	❒	❒	❒	❒
Before 2010	2010	2011	2012	2013	2014	2015	2016

    ❒ I have not taken a web-based fire service training course

13. I would like to complete at least one web-based training course within the next 12 months. (Choose only one answer.)

Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
❒	❒	❒	❒

14. All firefighters, regardless of number of years of experience, should routinely participate in training (either traditional or web-based). (Choose only one answer.)

Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagree
❒	❒	❒	❒

15. If you have enrolled in a web-based fire service training since 2010, which training provider(s) did you use? (Check all that apply to you.)

- ❒ South Carolina Fire Academy (SCFA, scfaonlinetraining.org)
- ❒ National Fire Academy (NFA Online Courses)
- ❒ National Fallen Firefighters Foundation (NFFF, fireherolearningnetwork.com)
- ❒ Responder Safety (respondersafety.com)
- ❒ Target Solutions (targetsolutions.com)
- ❒ National Volunteer Firefighter Council (NVFC Virtual Classroom)
- ❒ National Fire Protection Association (NFPA)
- ❒ Other (please specify): _____
- ❒ I have taken web-based training in the past, but I do not remember the provider.
- ❒ I have never enrolled in a web-based fire service training course.

16. If you have participated in a web-based SCFA (scfaonlinetraining.org) course, which of the following have you taken? (Check all that apply to you.)

SCFA Fully Online Courses:

- ❒ Introduction to Technical Rescue
- ❒ Photovoltaic (PV) 101
- ❒ Emergency Response to Highway Incidents
- ❒ Fire Chief 101
- ❒ Emergency Vehicle Response Awareness
- ❒ Modern Construction Considerations for Company Operations
- ❒ Improving Tactical Decision Making
- ❒ ISFSI—Thinking Firefighters
- ❒ Hazardous Materials Awareness

SCFA Hybrid Courses:

- ❒ Hazardous Materials Operations
- ❒ Hybrid Firefighter I
- ❒ NFPA Firefighter II
- ❒ CTC Firefighter I Hybrid
- ❒ CTC Firefighter II Hybrid

SCFA Blended Courses:

- ❒ Fire Officer I Blended
- ❒ Fire Instructor I Blended

❒ **None of the above.** I have not taken an SCFA web-based course.

SECTION V: Tell us your opinions concerning web-based fire service training.

Indicate the level to which you agree or disagree with each statement by checking the box on the scale.

	Strongly agree	Somewhat agree	Somewhat disagree	Strongly disagee
17. I learn better on my own, rather than with others.	❒	❒	❒	❒
18. Web-based delivery provides more training opportunities for me.	❒	❒	❒	❒
19. For knowledge-based learning that does not require hands-on practice, web-based delivery is as effective as face-to-face delivery.	❒	❒	❒	❒
20. Web-based courses are high quality.	❒	❒	❒	❒
21. I feel confident I have the computer skills needed to participate in a web-based training course.	❒	❒	❒	❒
22. In my situation, it would be difficult to participate in web-based training.	❒	❒	❒	❒
23. The benefits of web-based training are apparent to me.	❒	❒	❒	❒
24. Most firefighters I know hold positive views toward web-based training.	❒	❒	❒	❒
25. I have previously participated in web-based training.	❒	❒	❒	❒
26. I am aware of the way web-based training works or functions.	❒	❒	❒	❒
27. I have observed others participating in web-based training.	❒	❒	❒	❒
28. I am aware of other firefighters who have benefitted from participation in web-based training.	❒	❒	❒	❒
29. I like having control over when and where I learn.	❒	❒	❒	❒
30. I believe web-based training provides a positive change for the fire service.	❒	❒	❒	❒
31. Fire service culture facilitates the use of web-based training.	❒	❒	❒	❒
32. Participation in web-based training is voluntary; I can use web-based training on my own.	❒	❒	❒	❒
33. Fire department leaders encourage the use of web-based training.	❒	❒	❒	❒

34. Which of the following factors would most likely prevent you from taking a web-based training course? (Check all that currently apply to your situation.)

- ❒ I am too busy to take a web-based course.
- ❒ I have children or other family commitments that limit my spare time.
- ❒ I think I would feel lonely taking a web-based course.
- ❒ I have never seen what a web-based training course looks like.
- ❒ I probably lack the self-motivation needed to complete a web-based course.
- ❒ I learn better in a face-to-face training class.
- ❒ I do not have experience taking a web-based course.
- ❒ I was not satisfied with a previous web-based course.
- ❒ I would not enjoy a web-based class.
- ❒ My fire service superiors discourage the use of web-based training.
- ❒ Firefighters I work with have taken a web-based course and they did not like it.\
- ❒ I do not have access to a computer.
- ❒ I do not have access to a good-quality internet connection.
- ❒ I do not want to spend money on enrollment or other training fees.

35. If you do not intend to take a web-based course, what is the main reason? (Fill in the blank.)

_____

36. Which factors would most likely motivate you to take a web-based training course? (Check all that currently apply to your situation.)

- ❒ I find web-based training more convenient than face-to-face training.
- ❒ I have more options if I use web-based training in addition to face-to-face training.
- ❒ Web-based training provides standard quality and consistent delivery.
- ❒ I enjoy learning on my own.
- ❒ Web-based learning reduces or eliminates the need to travel.
- ❒ I like not having to pay for travel or submit claims for travel reimbursement.
- ❒ I learn better in a web-based course.
- ❒ Web-based learning reduces the duration of training.
- ❒ Another firefighter recommends web-based training.
- ❒ My fire service superiors require it.
- ❒ Nothing can motivate me—I will not take a web-based training course.

37. If you intend to take a web-based training course in the future, what is the main reason that motivates you? (Fill in the blank.)

_____

SECTION VI: Please share your thoughts on ways to improve or encourage the use of web-based training delivery.

38. What web-based training topic(s) do you feel are most needed or would interest you most? (Write your answer below.)

_____

_____

_____

_____

_____

_____

39. What do you see as a main challenge that could prevent the widespread adoption of web-based training in the rural fire service? (Write your answer below.)

_____

_____

_____

_____

_____

_____

40. In your opinion, what may be some ways to increase the adoption of web-based training among rural volunteers? Consider options for you personally, strategies for other individuals, changes at local departments, initiatives at the state level, or improvements in technology infrastructure or training delivery. (Write your answer below.)

_____

_____

_____

_____

_____

_____

SECTION VII: Tell us about you.

41. What is your gender?

❒ Male ❒ Female ❒ I prefer not to reveal my gender

42. Are you an active firefighter? (Do you currently go out on fire calls?)

❒ Yes ❒ No

43. How do you self-identify?

❒ American Indian / Native Alaskan
❒ Asian
❒ Black / African American
❒ White
❒ Other (specify): _____
❒ I prefer not to reveal my race/ethnicity

44. How old are you? _____ (Fill in the blank.) ❒ I prefer to not reveal my age

45. What is the highest level of education you have completed? (Check only <u>one</u> answer.)

❒ Some high school
❒ High school graduate
❒ Technical school
❒ Some college
❒ Associate's degree (2-year degree)
❒ Bachelor's degree (4-year degree)
❒ Master's or doctoral degree
❒ I prefer not to reveal my level of education

46. How would you personally deal with an unexpected $500 car repair or a $1000 healthcare expense? *(Please note: Information about disposable income can give a general indication of income level of survey participants, which relates to the theoretical framework of this study.)*

❒ Pay for it with savings
❒ Reduce spending on other things
❒ Charge it to a credit card and pay off the balance over several months
❒ Borrow money from family members or friends
❒ Other (please specify): _____
❒ I prefer not to reveal information about my disposable income

47. Approximately how many years of fire service experience do you have? _____
(Fill in the blank.)

❒ I prefer not to reveal information about my years of service

48. What is your rank or primary fire department role? (Check only one answer.)

❒ No rank or not applicable
❒ Explorer or junior member
❒ Recruit or trainee
❒ Firefighter
❒ Firefighter / paramedic
❒ Driver / operator / engineer
❒ Communications / public information officer
❒ Company officer
❒ Department training officer or instructor
❒ Chief officer
❒ Fire chief
❒ Public safety officer
❒ Other (please specify): _____
❒ I prefer not to reveal my rank or position

49. What is your fire department type? (Check only one answer.)

❒ All volunteer firefighters
❒ Combination department, mostly volunteer firefighters
❒ Combination department, mostly career firefighters
❒ Fire brigade
❒ Other (please specify): _____

50. Are you a career firefighter (currently on salary)?

❒ Yes ❒ No

ONE FINAL QUESTION!

Are you willing to participate in a brief phone interview sometime this fall on topics related to this questionnaire, should the overall results of this survey require clarification? We will not share your contact information with anyone.

If you fill in your contact information, detach this page from the questionnaire to help ensure your anonymity.

❒ No, thanks.

❒ Yes, I am willing to participate in a 15-minute phone interview. I have included my contact information below. I understand the researcher may or may not call, depending on the results of the survey.

❒ Please enter me in the drawing for a chance to win one of several $10 cash prizes. I have included my contact information below.

Name: _____

Street address: _____

City/State/Zip: _____

Email address: _____

Phone: _____

This concludes the questionnaire. Thank you for your time! We appreciate your assistance!

If you have questions or would like to know the overall survey results when tabulated, feel free to contact:

Margi Stone Cooper
flyingc@okstate.edu

Appendix B

Literature Review Summary

When examining the literature concerning issues with web-based learning in related fields, it becomes apparent that many of the same factors could apply to web-based training for rural firefighters. Thus, these issues might warrant further examination. The following list summarizes potential barriers to web-based training for rural firefighters identified in this literature review. For convenience, the researcher organized this list of potential issues into five categories—resources (i.e., computers, devices, high-speed internet, LMS, knowledge, skills), instructor and student responsibilities, social units (i.e., department members, state training organizations, family members), requirements and policies (i.e., training requirements, SOPs, IT policies, organizational culture, traditions), and perceived need for web-based training.

Lack of Resources

- Constraints of the LMS (Blin & Munro, 2008)
- Lack of computer or instructor support (Muilenburg & Berge, 2001; Holmgren, 2015)
- Do not own a cellular device (Anderson, 2015; Smith, 2015)
- Lack of technology or computer skills (Muilenburg & Berge, 2001)
- Lack of technology infrastructure or connectivity (Muilenburg & Berge, 2001; Hassel & Dean, 2015; Jerin & Rea, 2005; Kuttner, 2012; Prins et al., 2014; FCC, 2015; Sprenger, 2002)
- Low income or lack of money for training (Lawrence, 2013; Prins et al., 2014; Hassel & Dean, 2015; Butcher & Rose-Adams, 2015; Whitacre, 2010)
- Rural location (Hannun et al., 2009; Johnson & Strange, 2007; Marré, 2014; LaRose et al., 2007; Whitacre, 2010)
- Lack of time (Muilenburg & Berge, 2001; Terras & Ramsay, 2015; Butcher & Rose-Adams, 2015)

Instructor and Student Responsibilities

- Preference for traditional training (Taber, 2008; Sommer & Njå, 2011; Muilenburg & Berge, 2005; Rabiee et al., 2013)
- Shift in instructor and student roles in an online environment (Holmgren, 2012, 2013, 2015; Salbashian, 2009; Mayadas et al., 2009; Lloyd et al., 2012; Nazarian & Gharibshaeyan, 2013; McKay, 2012; Holmgren, 2015)
- Training aligned with specific roles in the fire service (Sommer & Njå, 2011; Holmgren, 2014b)
- Insufficient instructor training (Karasavvidis, 2009; Blin & Munro, 2008; Holmgren, 2014)

- Lack of self-motivation, self-regulation, and other online learning skills (Muilenburg & Berge, 2005; Donavant, 2009; Somers, 2007; Maxfield & Fisher, 2012)
- Lack of online learning experience (Muilenburg & Berge, 2005; Somers, 2007)
- Lower education level (Kobziar, 2009; Prins et al., 2014; Whitacre, 2010; Holmgren, 2013)
- Demographics (Somers, 2007; LaRose et al., 2007; Whitacre, 2010)

Social Units

- Family obligations (Butcher & Rose-Adams, 2015; Prins et al., 2014; McLennan & Birch, 2005; Penz et al., 2007)
- Institutional size (Allen et al., 2016)
- Group dynamics (Cox, 2012; Stinchcomb & Orgaz, 2007; Lucas & Kline, 2008; Levine & Mooreland, 1990)
- Negative perceptions of web-based training held by administrators (Muilenburg & Berge, 2005)
- Negative perceptions of instructors, supervisors, and other firefighters (Bayne & Ross, 2014; Allen & Seaman, 2012; Lloyd et al., 2012; Blin & Munro, 2008; NVFC, 2010)

Requirements and Policies

- Training requirements (NFPA, n.d.; NFPA, 2016; OSHA, 2015; NIOSH, 2009; Blin & Munro, 2008)
- Fire service traditions or culture (Lucas & Kline, 2008; Kier, 1995; Stinchcomb & Ordaz, 2007; Cox, 2012; Willower, 1963; Johnson, 2006; Baigent, 2009)
- Fire service organizational structure (Davidson, 2010)
- Curriculum or course design (Tarr, 2007; Milan, 2003; Luedtke, 2009; Weston, 2009; Muilenburg & Berge, 2001; Mayes, 2010; Berg, 2005; Maxfield & Fisher, 2012)

Perceived Need for Web-Based Training

- Lack of awareness of the importance of training or negative attitudes toward training and education in general (Darbyshire, 1993)
- Negative perceptions of web-based training held by the student (Somers, 2007)
- User may not see the need for the innovation (Rogers, 2003)
- Course content does not address training needs or does not apply to professional experiences (Courtney et al., 2002; Ray, 2012)

Appendix C

Questionnaire Items by Research Question

1. Do rural firefighters in South Carolina know about web-based training?

1a. Are rural firefighters aware of web-based training opportunities, and are there differences in the levels of awareness by group?

6. To what extent are you aware of web-based fire service training opportunities?

41. What is your gender?

42. Are you an active firefighter?

43. How do you self-identify?

44. How old are you?

45. What is the highest level of education you have completed?

46. How would you personally deal with an unexpected $500 car repair or a $1000 healthcare expense?

47. Approximately how many years of fire service experience do you have?

48. What is your rank or primary fire department role?

49. What is your fire department type?

50. Are you a career firefighter (currently on salary)?

1b. Which channels of communication do rural firefighters most often use to seek information about training opportunities?

4. Which of the following types of media do you use at least once a week?

5. Through which sources are you most likely to find out about fire service training opportunities (web-based and face-to-face courses)?

7. If you have a question about web-based training in general, where do you first turn for an answer or opinion?

2. Have rural firefighters in South Carolina been persuaded to participate in web-based training?

2a. Have rural firefighters formed favorable opinions about web-based training?

1. Which of the following types of technology do you use regularly at work, at the fire station, or at home?

3. At which locations can you watch videos on the internet using a computer, tablet, or phone without the media periodically freezing up?

8. Have you received fire service-related training, either through your local department, statewide agency, or a national organization?

9. How often do you participate in face-to-face training activities conducted by your department?

13. I would like to complete at least one web-based training course within the next 12 months.

14. All firefighters, regardless of number of years of experience, should routinely participate in training (either traditional or web-based).

17. I learn better on my own, rather than with others.

18. Web-based delivery provides more training opportunities for me.

19. For knowledge-based learning that does not require hands-on practice, web-based delivery is as effective as face-to-face delivery.

20. Web-based courses are high quality.

21. I feel confident I have the computer skills needed to participate in a web-based training course.

22. In my situation, it would be difficult to participate in web-based training.

23. The benefits of web-based training are apparent to me.

24. Most firefighters I know hold positive views toward web-based training.

25. I have previously participated in web-based training.

26. I am familiar with how web-based training works or functions.

27. I have observed others participating in web-based training.

28. I am aware of other firefighters who have benefitted from participation in web-based training.

29. I like having control over when and where I learn.

30. I believe web-based training provides a positive change for the fire service.

31. Fire service culture facilitates the use of web-based training.

32. Participation in web-based training is voluntary; I can use web-based training on my own.

33. My fire department leaders encourage the use of web-based training.

2b. Do rural firefighters participate in web-based training?

11. How many fully or partially web-based fire service training courses have you taken since 2010?

12. If you have participated in web-based fire service training in the past, to the best of your recollection, in what year did you take your first course?

15. If you have enrolled in a web-based fire service training since 2010, which training provider(s) did you use?

16. If you have participated in a web-based SCFA (scfaonlinetraining.org) course, which of the following have you taken?

2c. Do rural firefighters perceive barriers to the use of web-based training?

34. Which of the following factors would most likely prevent you from taking a web-based training course?

35. If you do not intend to take a web-based course, what is the main reason?

36. Which factors would most likely motivate you to take a web-based training course?

37. If you intend to take a web-based training course in the future, what is the main reason that motivates you?

38. What web-based training topic(s) do you feel are most needed or would interest you most?

39. What do you see as a main challenge that could prevent the widespread adoption of web-based training in the rural fire service?

40. In your opinion, what may be some ways to increase the adoption of web-based training among rural volunteers? Consider options for you personally, strategies for other individuals, changes at local departments, initiatives at the state level, or improvements in technology infrastructure or training delivery.

Appendix D

Partial List of Fire and Emergency Response-Related Web-Based Training Providers

American Heart Association, CPR & First Aid (http://cpr.heart.org/AHAECC/CPRAndECC/Training/HealthcareProfessional/BasicLifeSupportBLS/UCM_476240_CPR-BLS-for-Prehospital-Providers.jsp?pmc=EMS1-PCSED)

CDC, Emergency Preparedness and Response, Public Health Planning for Radiological and Nuclear Terrorism (http://emergency.cdc.gov/radiation/masscasualties/publichealthplanning.asp)

CFITrainer.net, International Association of Arson Investigators (http://www.cfitrainer.net)

COMET MedEd, SKYWARN Spotter Training (https://www.meted.ucar.edu/training_course.php?id=23)

Evolve e-Learning Solutions, OSHA Courses (http://www.evolveelearning.com/courses-osha-safety-training.html)

FireDex University (http://www.firedex.com/training/)

Firefighters Support Foundation (http://www.ffsupport.org)

FireRescue1, Fire Online Training (http://www.firerescue1.com/fire-products/online-training/)

FEMA Emergency Management Institute, Independent Study (http://training.fema.gov/is/)

International Association of Certified Home Inspectors (http://nachi.org)

John Hopkins School of Public Health Improving Understanding and Collaboration Among First Responders (http://ocw.jhsph.edu/index.cfm/go/viewCourse/course/FirstResponders/coursePage/index/)

Kaplan FireEMS Academy (http://www.fireemsacademy.com)

Kentucky Emergency Medical Services for Children (http://kbems.kctcs.edu)

Louisiana State University, National Center for Biomedical Research and Training-Academy of Counter-Terrorist (http://www.ncbrt.lsu.edu)

Maryland State Police Training Commission (mdgunsafety.com)

Modern Fire Behavior, UL FSRI Courses (http://modernfirebehavior.com/apparatus/)

Multijurisdictional Counterdrug Task Force Training Program (MCTFT) (http://mctft.org)

National Fallen Firefighters Association, Everyone Goes Home, (http://www.everyonegoeshome.com/training/)

National Fire Protection Association, Alternative Fuels Vehicles Safety Training Program (http://evsafetytraining.org)

National Institute of Health (http://irtsectraining.nih.gov/publicUser.aspx)

National Institute of Justice, Forensic Science (http://nij.gov/topics/forensics/Pages/welcome.aspx)

National Wildfire Coordinating Group, NWCG Online Course Materials (http://onlinetraining.nwcg.gov)

New Mexico Tech Energetic Materials Research & Testing Center, New Mexico Institute of Mining and Technology (http://campus.emrtc.nmt.edu/campus/)

New Science-UL, Fire Safety (http://newscience.ul.com/firesafety)

North Carolina Center for Public Health Preparedness (NCCPHP) (https://nciph.sph.unc.edu/tws/index.php)

SAFE CSX Safety Awareness for Emergencies (http://www.csxsafe.com)

Safe Response.com (http://www.saferesponse.com)

SPC Corporate Training and Lifelong Learning Network (http://www.spcollege.edu/workforceinstitute/)

St. Petersburg College, Florida Regional Community Policing Institute (http://cop.spcollege.edu)

St. Petersburg College/National Terrorism Preparedness Institute (http://terrorism.spcollege.edu)

Texas A&M Engineering Extension Service (https://teex.org/Pages/default.aspx)

U.S. Fire Administration, National Fire Academy (https://www.usfa.fema.gov/training/nfa/courses/online.html)

U.S. Forest Service (http://www.fs.fed.us/fire/training/index.html)

U.S. Forest Service Aviation Training (https://www.iat.gov)

UL Firefighter Safety (http://ulfirefightersafety.com)

United States Institute of Peace (http://www.usip.org/online-courses)

University of Albany, School of Public Health (http://www.ualbanycphp.org/learning/default.cfm)

University of Minnesota School of Public Health, Continuing Education Online Courses (http://www.sph.umn.edu/academics/ce/online/)

InterFire Online (http://www.interfire.org)

WebAnywhere.com, Online Learning for Health & Safety Training and OSHA Compliance (http://www.webanywhere.com/workplace/our-solutions/health-and-safety)

Appendix E

Persuasion-Related Questionnaire Items Keyed to Diffusion Characteristics

Relative Advantage

18. Web-based delivery provides more training opportunities for me.

19. For knowledge-based learning that does not require hands-on practice, web-based delivery is as effective as face-to-face delivery.

20. Web-based courses are high quality.

23. The benefits of web-based training are apparent to me.

30. I believe web-based training provides a positive change for the fire service.

Compatibility

14. All firefighters, regardless of number of years of experience, should routinely participate in training (either traditional or web-based).

17. I learn better on my own, rather than with others.

24. Most firefighters I know hold positive views toward web-based training.

25. I have previously participated in web-based training.

26. I am familiar with how web-based training works or functions.

29. I like having control over when and where I learn.

31. Fire service culture facilitates the use of web-based training.

33. My fire department leaders encourage the use of web-based training.

Complexity

21. I feel confident I have the computer skills needed to participate in a web-based training course.

22. In my situation, it would be difficult to participate in web-based training.

Trialability

13. I would like to complete at least one web-based training course within the next 12 months.

32. Participation in web-based training is voluntary; I can use web-based training on my own.

Observability

27. I have observed others participating in web-based training.

28. I am aware of other firefighters who have benefitted from participation in web-based training.

Appendix F

Email Message to Questionnaire Reviewers

To: Subject Matter Experts

Subject: Review of Questionnaire on Barriers to Web-Based Training

Thank you for offering your expertise as a person familiar with both traditional and web-based fire service training to help pilot the questionnaire for my dissertation research. Your input concerning the questionnaire will make this a better study. The questionnaire will be administered during the summer of 2016. Participants will include members of rural fire departments in another state. Through this study, I hope to determine whether rural firefighters know about and use web-based training.

Instructions for the Questionnaire Pilot:

1. The questionnaire includes 50 questions organized into seven sections.
2. Before you begin, please note the time so that you can report the number of minutes it took you to complete the questionnaire.
3. Complete the questionnaire as if you are a rural firefighter.
4. As a fire service subject matter expert, offer comment or suggestions for improving any questions.
5. Please complete this review within the next week. You may email your comments and suggestions to flyingc@okstate.edu.

I appreciate your time!

Appendix G

Survey Facilitator's Script

Hello, my name is _____, and I am with the South Carolina State Firefighters' Association. Thank you all for attending. I am here to request your participation in dissertation research led by a doctoral student at Oklahoma State University. Your participation is voluntary. However, your opinions matter, because the results of this study will benefit our state's fire service.

A consent form is attached to the front of the survey. Please take a moment to read the consent form.

The purpose of this study is to determine the level or awareness and acceptance of web-based training by rural firefighters in the State of South Carolina. We ask that each of you complete a printed questionnaire, which will take about 15 minutes.

The questionnaire also asks for volunteers for a possible follow-up phone interview. The need for follow-up information is unknown at this time. However, follow-up interviews may help explain any unexpected results. The last page of the questionnaire provides a space for you to write your name and contact information if you are willing to speak with the researcher by phone.

There are no known risks associated with this project.

You will receive no direct personal benefit by participating in this research. However, your participation can help our state's fire service.

The records of this study will remain confidential. Any written results will discuss findings of the group as a whole and will not include information that will identify you.

You will receive no compensation for completing the questionnaire. However, those who participate may enter their name in a drawing for one of 15 $10-cash prizes.

Again, your participation is voluntary. By detaching the form and completing the survey, you are agreeing to these terms and verifying you are at least 18 years of age.

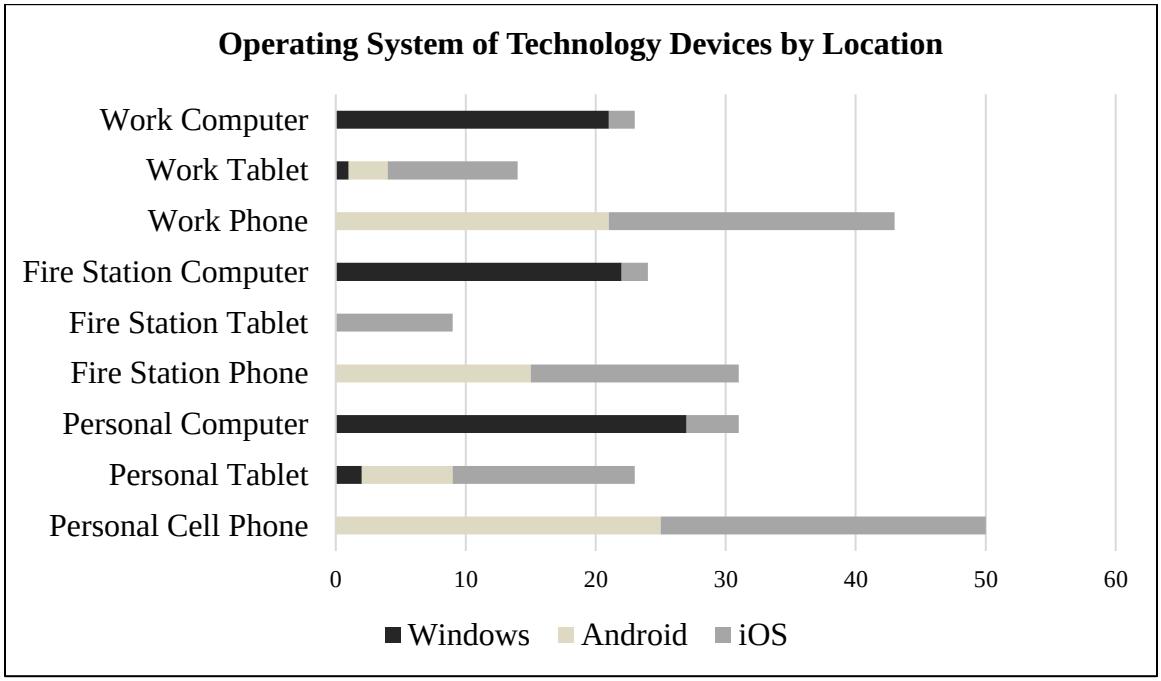
There are no right or wrong answers, so please give your honest opinions. The form includes 50 questions, most of which you answer by simply checking a box. In some cases, you may need to check more than one box. A few questions may require you to write just a few words or a few sentences.

If you have questions while filling out the survey, I will be happy to answer them for you. The researcher will also be available by phone during this time. You may contact either researcher at Oklahoma State University if you have questions about the study. Their contact information appears on the consent form.

When you are finished, I will gather the questionnaires. We will remove the consent form and the last page of the survey to remove any identifying information to ensure confidentiality.

Are there questions before we begin? If not, I will pass out the questionnaires.

Appendix H



Number of respondents with access to Windows, Android, or iOS/Apple computers, tablet, and cell phones by location (n=54).

Technology Used Regularly at Work, at the Fire Station, and at Home (n=54)

	Percent of Respondents with Access by Location		
Device	Work	Fire Station	Home
iPhone	35.2	25.9	42.6
iPad	18.5	14.8	25.9
iOS computer	1.9	0.0	3.7
Android phone	35.2	24.1	40.7
Android tablet	5.6	0.0	13.0
Windows tablet	1.9	0.0	3.7
Windows computer	38.9	40.7	48.1

Note. Participants indicated all devices and all locations in which they are used. Thus, the total of the percentages does not equal 100.

Appendix I

Traditional Training Courses Attended by Respondents

Firefighter I, 1153 (24)

Firefighter II, 1154 (19)

Fundamentals of Firefighting, 1152 (11)

Basic Auto Extrication (10)

Incident Command System (NIMS-ICS) (10)

Pump Operations (8)

Fire Instructor I (7)

Basic Fire and Emergency Responder, 1701 (6)

Emergency Vehicle Driver Training (6)

Hazmat* (5)

Hazmat Technician (4)

Fire Officer I (3)

Fire Officer II (3)

Low-Angle Rope Rescue (3)

Rope Rescue Operations (3)

Aerial Operations (2)

Blood Borne Pathogens (2)

CPR (2)

Fire Officer III (2)

First Responder (2)

Hazmat Operations (2)

Number in parenthesis ( ) indicates the number of times mentioned.
*Respondents did not specify which level of hazmat training.

Appendix J

Web-Based Training Listed by Respondents

SCFA Web-Based Courses Most Frequently Taken (scfaonlinetraining.org) (n=54)

SCFA Web-Based Courses (Year Released)	Percent
Fully online	
Hazardous Materials Awareness (2010)	20.4
Emergency Vehicle Response Awareness (2012)	20.4
Emergency Response to Highway Incidents (2013)	18.5
Fire Chief 101 (2014)	18.5
Photovoltaic 101 (2015)	16.7
Improving Tactical Decision Making (2012)	13.0
IFSFI—Thinking Firefighters (2013)	11.1
Introduction to Technical Rescue (2015)	9.3
IFSFI—Modern Construction Considerations for Company Operations (2012)	3.7
Hybrid	
Hazardous Materials Operations	9.3
Hybrid NFPA Firefighter I	5.6
Hybrid NFPA Firefighter II	1.9
CTC Firefighter I Hybrid	1.9
CTC Firefighter II Hybrid	1.9
Blended	
Fire Officer I Blended	1.9
Fire Instructor I Blended	0.0
Have not taken an SCFA web-based course	50.0

Note. Participants indicated all SCFA web-based courses they had taken. Thus, the total percentage does not equal 100.

Appendix K

Likely Deterrents to Participation in Web-Based Training

Factors Most Likely to Prevent Participation in a Web-Based Training Course (n=44)

Factor	Percent
I learn better in a face-to-face course	38.9
I am too busy to take a web-based course	24.1
I have children or other family commitments that limit my spare time	24.1
I probably lack self-motivation needed to complete a web-based course	16.7
I have never seen what a web-based course looks like	13.0
I do not want to spend money on enrollment or other training fees	13.0
I do not have experience taking a web-based course	13.0
I do not have access to a good-quality internet connection	11.1
I do not have access to a computer	5.6
My fire service supervisors discourage the use of web-based training	3.7
I think I would likely feel lonely taking a web-based course	3.7
I would not enjoy a web-based course	1.9
I was not satisfied with previous web-based course	1.9
Firefighters I work with have taken a web-based course and they did not like it	0.0

Note. Participants were asked to indicate all factors that applied to them. Thus, the total percentage does not equal 100.

Appendix L

Main Challenges to Widespread Adoption of Web-Based Training

Poor internet service (14)

No free time (6)

No access to a computer (4)

No experience with web-based training (3)

Unaware opportunities exist (2)

Generational preferences of learners (2)

Fire service mindset

Needs more hands-on components

Lack of computer skills

Too few topics available

High cost of technology

Number in parenthesis ( ) indicates frequency, if mentioned more than once.

Appendix M

Training Topics Needed

Do not know (4)
Anything (3)
Fire behavior (3)
Firefighter I and II, 1152 (4)
Auto extrication, including hybrid vehicles (2)
Basic fire training refresher (2)
Executive Officer/Chief Officer (2)
Hazmat* (2)
Structure fires (2)
Technical rescue (2)
Budgeting and recordkeeping
Building construction
Equipment operation
Extrication
Fire Chief 101
Fire flow paths
Fire ground communications
Fire service history
Firefighter tactics
Foam applications
Hazmat awareness level
Inspection
Introduction to fire, simplified training
None
Protecting others and property
Pump operations
Rescue tools
Safety tech
SCBA
Tool demonstrations
Updates of fire-related courses
Vehicle accidents
Vent-Enter-Isolate-Search (VEIS)
Wildlands

Number in parenthesis ( ) indicates frequency, if mentioned more than once.
*Respondents did not specify which level of hazmat training.

Appendix N

Ways to Increase the Use of Web-Based Training

Better promotion of training opportunities (4)

Computers available at fire stations (4)

Increase access to better internet service (3)

Provide computers and internet service at fire stations and/or technology funding (3)

Train local experts (2)

Offer web-based training on more topics

Make it easier to access

Research effectiveness of web-based training

Increase interest in firefighting

Offer formal training credit

Offer more video-based courses

Number in parenthesis ( ) indicates frequency, if mentioned more than once.

Appendix O

Pilot Results

Table P-1

Personal Demographics of Respondents (n = 12)

Questionnaire Item	Responses	Frequency	Percent
Gender	Male	12	100.00
	Female	0	0.00
Years of age	19 or younger	1	8.33
	20-29	4	33.33
	30-39	3	25.00
	40-49	1	8.33
	50-59	1	8.33
	Over 60	0	0.00
	Did Not Reveal	1	8.33
Race/ethnicity	White	10	83.33
	Black	1	8.33
	Other (Asian)	1	8.33
Education level	High school	5	41.67
	Technical school	0	0.00
	Some college	3	25.00
	Associate's or bachelor's degree	4	33.33
	Did not reveal	0	0.00
Means for meeting an emergency expense (level of disposable income)	Use cash on hand	4	33.33
	Reduce spending	1	8.33
	Use credit or borrow money	6	50.00
	Did not reveal	1	8.33

Note. Due to rounding errors, not all totals equal 100 percent.

Table P-2

Firefighter-Related Demographics of Respondents (n = 12)

Questionnaire Item	Responses	Frequency	Percent
Actively serving as a firefighter	Yes	12	100.00
	No	0	0.00
Department type	All-volunteer	5	41.67
	Combination	7	58.88
	Did not reveal	0	0.00
Firefighter type	Volunteer	7	58.33
	Career	5	41.67
	Did not reveal	0	0.00
Rank or role	Firefighter	6	50.00
	Fire chief	1	8.33
	Driver-operator	2	16.67
	Company officer	1	8.33
	Training officer	1	8.33
	Assistant chief	1	8.33
	Did not reveal	0	0.00
Years of fire service experience	1-4	2	16.67
	5-9	4	33.33
	10-14	1	8.33
	15-19	2	16.67
	20-29	3	33.33
	Did not reveal	0	0.00

Note. Due to rounding errors, not all totals equal 100 percent.

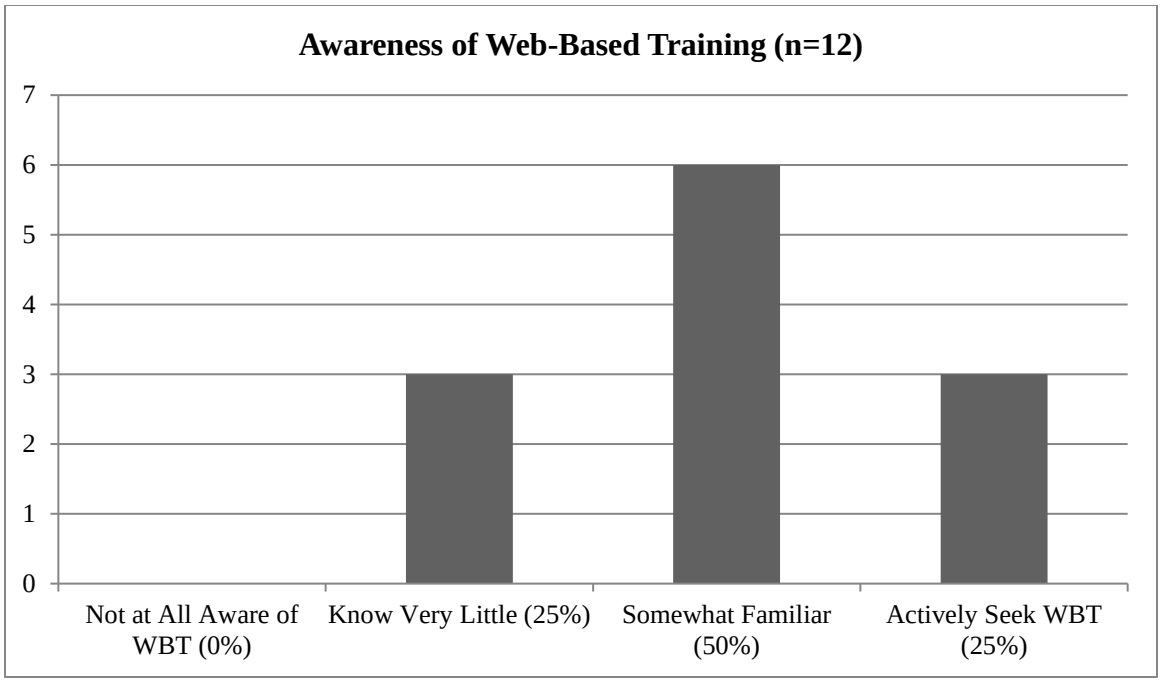


Figure P-1. Percentages for level of awareness of web-based training opportunities.

Table P-3

Frequency and Mean for Awareness of Web-Based Training by Age

Age Groups	n	Mean
20-29	5*	2.20
30-39	4	2.25
40-49	1	2.00
50-59	1	1.00
Over 60	0	0.00
Did not reveal age	1	1.00
Total	12	2.00

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

*The group included one 19-year-old respondent.

Table P-4

Frequency and Mean for Awareness of Web-Based Training by Department Type

Department Type	n	Mean
All-volunteer	5	1.80
Combination	7	2.14
Total	12	2.00

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table P-5

Frequency and Mean for Awareness of Web-Based Training by Level of Disposable Income

Means for Handling a $500-1000 Emergency Expense	n	Mean
Use cash on hand	4	2.50
Reduce spending	1	2.00
Use credit or borrow money	6	1.67
Did not reveal disposable income	1	2.00
Total	12	2.00

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table P-6

Frequency and Mean for Awareness of Web-Based Training by Years of Fire Service Experience

Years of Fire Service Experience	n	Mean
1-4	2	2.50
5-9	4	1.75
10-14	1	2.00
15-19	2	2.50
20-29	3	1.67
More than 30	0	0.00
Total	12	2.00

Note. 1 = Not at all aware, 2 = Know very little, 3 = Somewhat familiar, 4 = Actively seek courses.

Table P-7

Likely Sources for All Types of Training Information (n=12)

Information Source	Frequency	Percent
Fire department meetings	11	91.67
Communication from fire chief or training officer	11	91.67
South Carolina Fire Academy (SCFA) website	8	66.67
Fire department bulletin boards	7	58.55
Social media, such as Twitter and/or Facebook	7	58.33
South Carolina State Firefighters' Association (SCSFA) website	6	50.00
Newsletter sent in the standard mail or email	4	33.33
Communication from SCFA regional office	0	0.00
Other source	0	0.00

Note. Participants indicated all information sources they used. Thus, the total of the percentages does not equal 100.

Table P-8

Preferred Source for Training Information (n=12)

Information Source	Frequency	Percent
Fire department superior	7	58.33
Internet search	0	0.00
SCFA or regional staff	2	16.67
SCSFA	1	8.33
Another firefighter	1	8.33
Other	1	8.33

Table P-9

Frequency, Mean, and Standard Deviation for the Five Perceived Characteristics of the Innovation

	Persuasion Level Score	
Factors (Questionnaire Items)	n	Mean
Relative advantage (18, 19, 20, 23, 30)	12	2.85
Compatibility (14, 17, 24, 25, 26, 29, 31, 33)	12	2.95
Complexity (21, 22)	12	3.33
Trialability (13, 32)	12	3.25
Observability (27, 28)	12	3.04

Note. 1 = Strongly disagree, 2 = Somewhat disagree, 3 = Somewhat agree, 4 = Strongly agree.

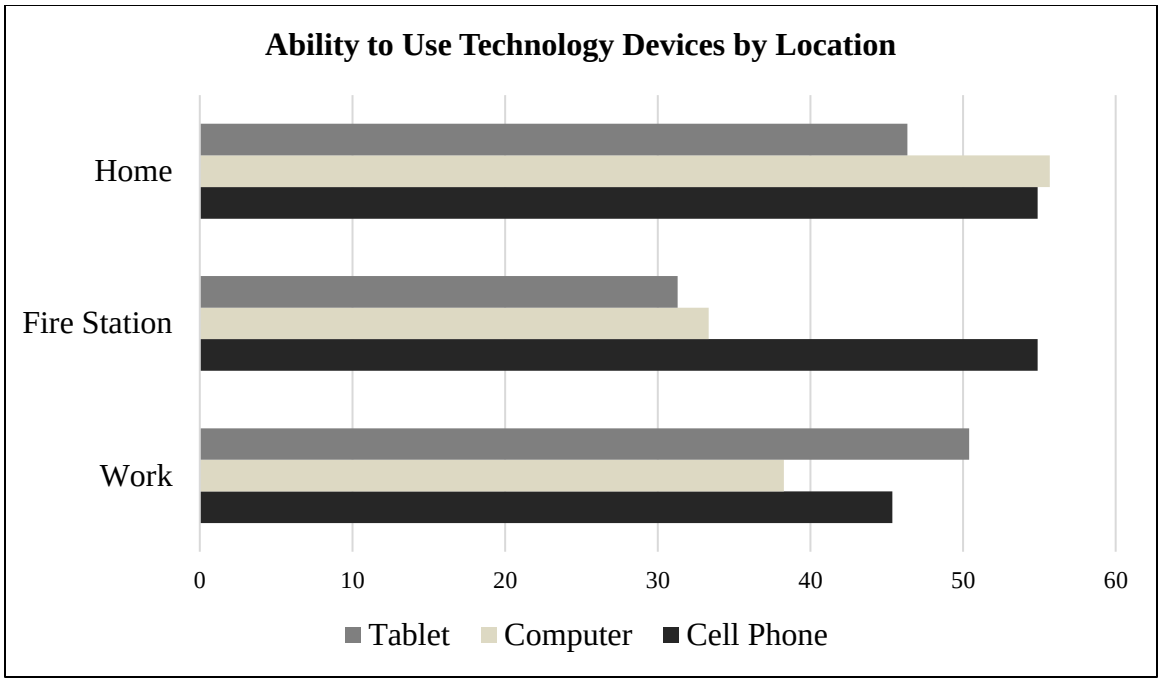


Figure P-2. Percentage of respondents who had access to tablets, computers, and cell phones by location (n=12).

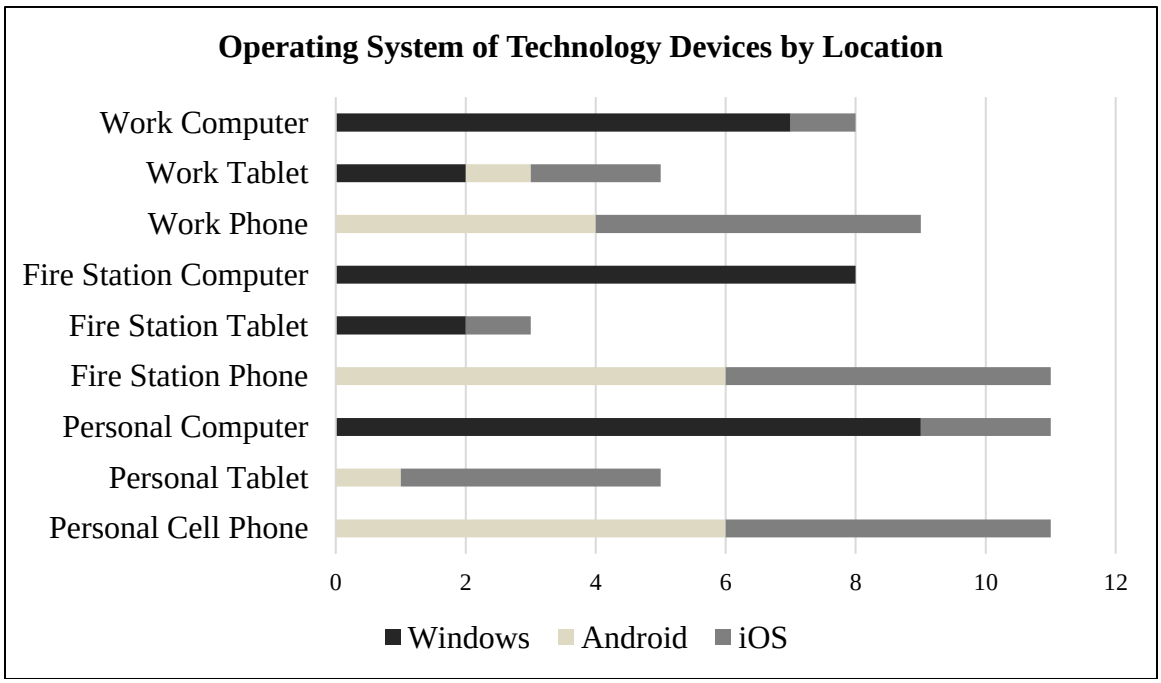


Figure P-3. Number of respondents with access to Windows, Android, or iOS/Apple computers, tablet, and cell phones by location (n=12).

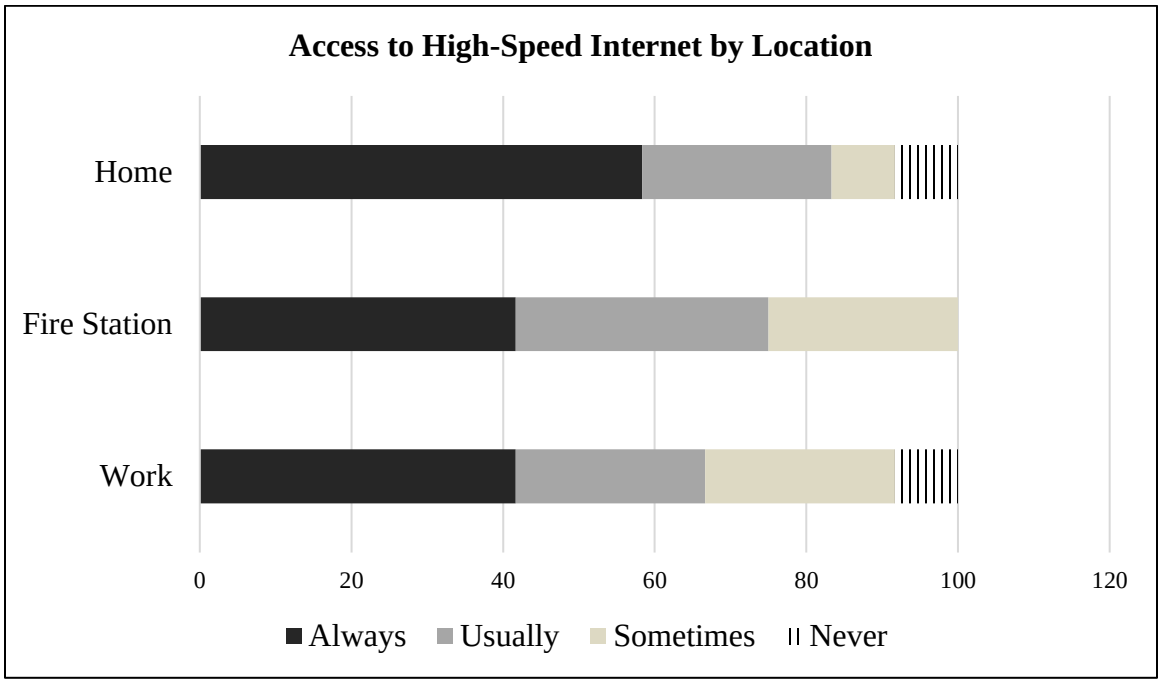


Figure P-4. Percentage of respondents who had access to high-speed internet by location (n=12).

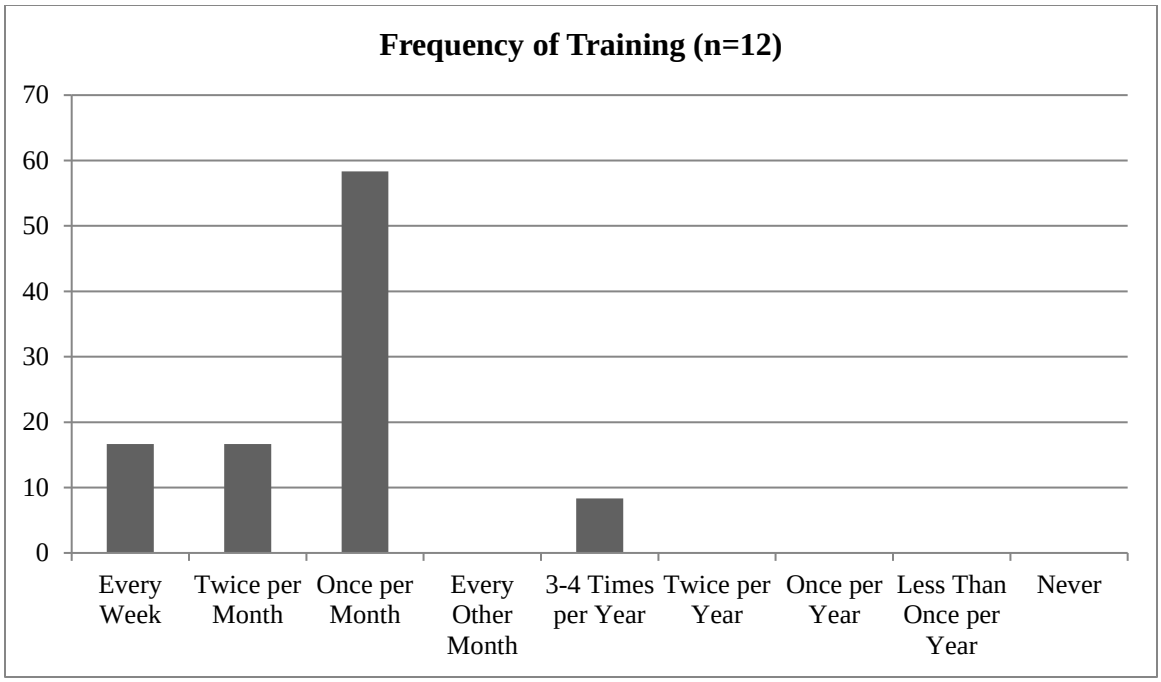


Figure P-5. Frequency of firefighter training.

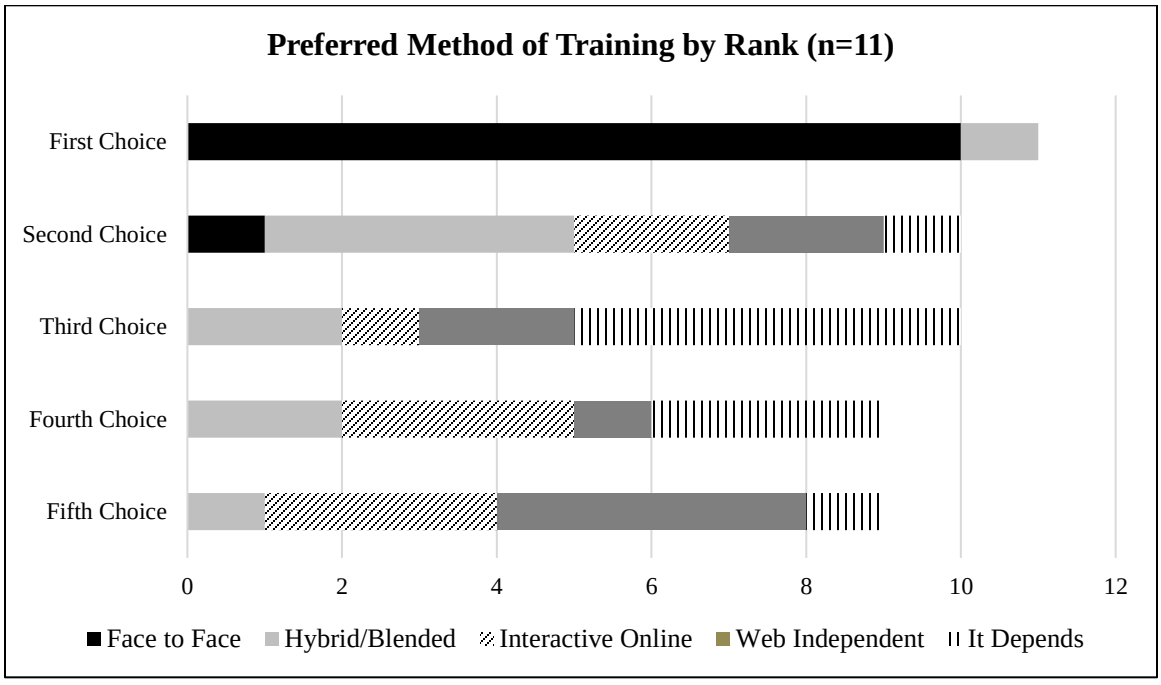


Figure P-5. Rankings for preferred method of training delivery for the pilot study: 1) face-to-face, 2) hybrid or blended, and 3) it depends on the situation, 4) fully online courses that allow interaction with the instructor, and 5) web-based independent study courses.
Note. One respondent only gave their top three choices and one only their top choice.

Table P-10

Traditional Training Courses Attended by Respondents (n=12)

Training Topics	Frequency
Firefighter I (1153)	24
Firefighter II	16
Fundamentals of Firefighting (1152)	11
Basic Auto Extrication	10
Incident Command System (NIMS-ICS)	10
Pump Operations	8
Fire Instructor I	7
Basic Fire and Emergency Responder (1701)	6
Emergency Vehicle Driver Training	6
Hazmat	5

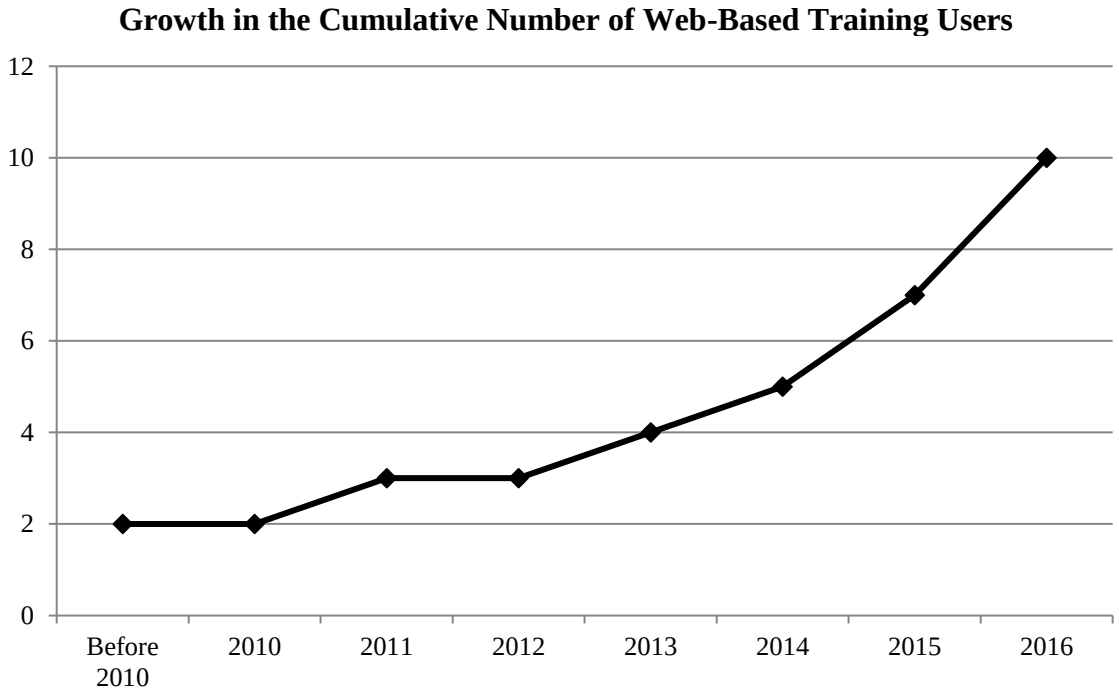


Figure P-6. Cumulative number of web-based training users by year (n=10).

Table P-11

Number of Fully and Partially Online Courses Taken (n=12)

Number of Courses Taken	Frequency	Percent
0	2	16.67
1	3	25.00
2	3	25.00
3 or more	4	33.33

Table P-12

Likelihood of Taking a WBT Course within 12 Months (n=12)

Response	Frequency	Percent
Strongly agree	5	41.67
Somewhat agree	6	50.00
Somewhat disagree	1	8.33
Strongly disagree	0	0.00

Table P-13

Belief that All Firefighter Should Regularly Participate in Training (n=12)

Response	Frequency	Percent
Strongly agree	9	75
Somewhat agree	3	25
Somewhat disagree	0	0
Strongly disagree	0	0

Table P-14

Web-Based Training (WBT) Vendors Used (n=12)

Response	Frequency	Percent
SCFA, scfaonlinetraining.org	6	54.55
NFA Online Courses	1	9.09
NFFF, fireherolearningnetwork.com	0	0.00
Responder Safety (respondersafety.com)	3	27.27
Target Solutions (targetsolutions.com)	3	27.27
NVFC Virtual Classroom	1	9.09
NFPA	1	9.09
Other: Action Training	1	9.09
I don't remember the provider	0	0.00
I have never taken a WBT course	2	18.18

Note. Participants indicated all web-based training vendors they had used. Thus, the total of the percentages does not equal 100.

Table P-15

SCFA Web-Based Courses Most Frequently Taken (n=12)

SCFA Courses	Frequency	Percent
Fully online		
Emergency Response to Highway Incidents	5	41.67
Emergency Vehicle Response Awareness	4	33.33
Introduction to Technical Rescue	3	25.00
Hazardous Materials Awareness	3	25.00
IFSFI—Thinking Firefighters	1	8.33
Fire Chief 101	1	8.33
Modern Construction Considerations for Company Ops	0	0.00
Photovoltaic 101	0	0.00
Improving Tactical Decision Making	0	0.00
Have not taken an SCFA web-based course	4	33.33

Note. Participants indicated all SCFA web-based courses they had taken. Thus, the total of the percentages does not equal 100.

Table P-16

Factors Most Likely to Prevent Participation in a Web-Based Training Course (n=12)

Factor (Frequency)	Percent
I learn better in a face-to-face course (6)	54.55
I am too busy to take a web-based course (4)	36.36
I have children or other family commitments that limit my spare time (4)	36.36
I would not enjoy a web-based class (3)	27.27
I do not want to spend money on enrollment or other training fees (3)	27.27
I probably lack self-motivation needed to complete a web-based course (2)	18.18
I do not have experience taking a web-based course (1)	9.09
I do not have access to a high-speed internet connection (1)	9.09
I think I would feel lonely taking a web-based course (1)	9.09
I have never seen what a web-based course looks like (0)	0.00

Note. Participants indicated all factors that applied to them. Thus, the total of the percentages does not equal 100.

Table P-17

Main Challenge to Widespread Adoption of Web-Based Training (n=1)

Challenges	Frequency
Face-to-face training is better	1

Table P-18

Factors that Likely Encourage Use of Web-Based Training (n=12)

Motivation Factors	Frequency	Percent
Web-based training more convenient than face-to-face training	10	83.33
I prefer training that is free or very low cost	9	75.00
Web-based learning reduces or eliminates the need to travel	7	58.33
I have more options if I use web-based training	6	50.00
Consistent quality and delivery	5	41.67
Not having to submit travel claims for reimbursement	5	41.67
My fire service supervisors require it	5	41.67
I enjoy learning on my own	4	33.33
Another firefighter recommends web-based training	2	16.67
Web-based learning reduces the duration of training	2	16.67
I learn better in a web-based course	1	8.33

Table P-19

Main Motivation for Using Web-Based Training (n=5)

Challenges to Web-Based Training	Frequency
Opportunity to increase knowledge and skills	2
Convenience	1
Free (no cost)	1
Increase the number of training opportunities	1

Table P-20

Training Topics Needed (n = 5)

Response	Frequency
Medical topics	3
Extrication	1
New firefighter tactics	1
Fire Officer	1
EVDT	1
Hazmat road safety	1

Note. Some participants provided more than one answer.

Table P-21

Main Challenge to the Adoption of WBT in the Fire Service (n = 5)

Response	Frequency
Lack of time	4
Poor quality internet connection or lack of a computer	2
Family commitments	1

Note. Some participants provided more than one answer.

Table P-22

Ways to Increase the Use of Web-Based Training (n=5)

Response	Frequency
Provide easy/open access	2
Videos showing firefighting strategies	1
Make it a required part of training	1
Have it count as credit for advancing a person's career	1

VITA

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of Doctor of Philosophy

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